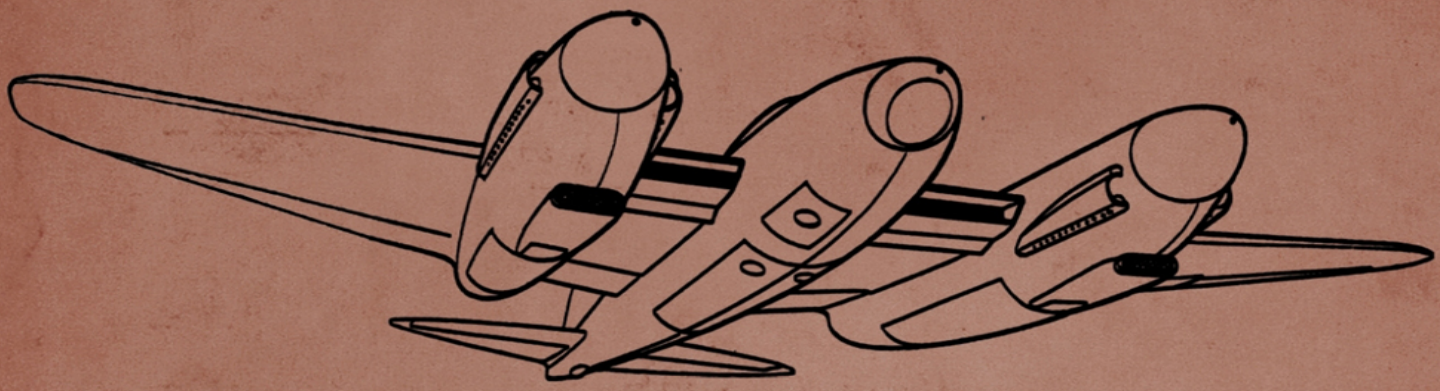
THE MOSQUITO POCKET MANUAL



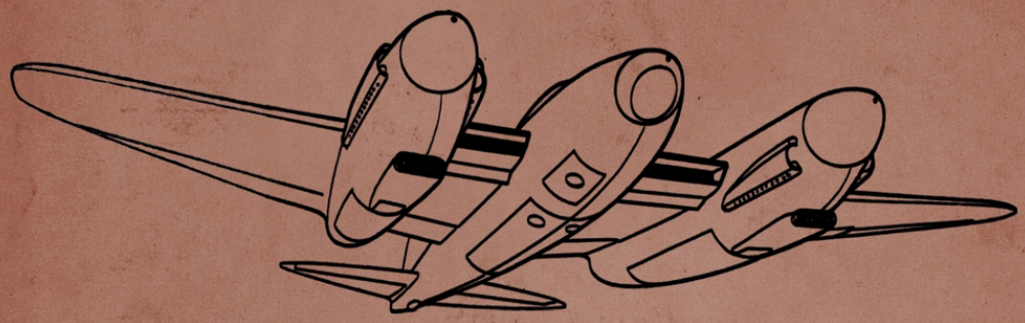
ALL MARKS IN SERVICE

1939-1945

AIR MINISTRY

BLOOMSBURY

THE MOSQUITO POCKET MANUAL



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THE MOSQUITO POCKET MANUAL

COMPILED AND INTRODUCED BY MARTIN ROBSON

CONWAY

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Introduction

‘The Mosquito represents all that is finest in aeronautical design’
Wing Commander John de Lacy Wooldridge, Commanding Officer, 105 Squadron

‘It had awesome power on the leash in those huge engines and was eager on its undercarriage like a sprinter on the starting blocks who couldn’t wait to leap up and away.’
Sergeant Mike Carreck

The image of the de Havilland Mosquito held by many of my generation is of a derring-do assault on a German V-2 rocket fuel plant in Norway conducted by the brave pilots of the RAF’s 633 Squadron. The stirring theme tune combined with whizzo (for their time) special effects was quite astounding to a small boy watching the drama unfold on the television. As a teenager I was disappointed to learn it was all a load of cinematic hokum, a fiction – for 633 Squadron never existed. Only once I began my academic career and having undertaken much research on the Mosquito did I realise that the core elements of that film were based on fact. These included the Mossie’s remarkable low-level flying capabilities, the many successful precision attacks on German targets across occupied Europe, the sheer bravery of the pilots and 618 Squadron’s real-life experimentation with Barnes Wallis’s Highball bombs. Today, the theme tune to *633 Squadron* is a car-journey favourite with my own boys, while it seems that when the X-Wing in *Star Wars* was conceived, George Lucas had the Mosquito in mind. The climactic scenes of *633 Squadron*, with model and real Mosquitos flying down a fjord to drop their bombs and seal up the entrance to the Nazi

factory, were transplanted to *Star Wars*, while the trench run assault on the Death Star recaptures some of the sheer flying ability of the Mosquito.

Pound for pound the Mosquito was the most effective British bomber of the Second World War. The aircraft excelled as a precision attack bomber, while its ability to find and hit specific targets found it often deployed in pathfinding roles ahead of a main bomber stream comprising heavies such as the Lancaster, or co-ordinating the main bomber stream as a Master Bomber. The Mosquito itself could carry a 4000lb 'cookie' bomb and could be adapted to carry Barnes Wallis's Upkeep mine or Highballs to attack German capital ships (leading warships). It was often deployed where accuracy was at a premium, such as in the bombing of the Oslo Gestapo HQ in September 1942.

But the Mosquito was far more than an accurate bomber. Like many British aircraft of the Second World War it was marinised (fully adapted) for service at and from the sea. With the legendary Eric 'Winkle' Brown at the controls, it was the world's first twin-engine aircraft to deck land on a carrier. It could carry rockets, and could be armed with a six-pounder cannon, excelling once again as a ground attack aircraft. Its speed allowed it to operate as a fighter and, equipped with radar, it excelled as a night fighter. Speed and stability were also key in the Mosquito's photo-reconnaissance role and again in 1944 when it was tasked with stopping German V-1 rockets by flipping them with its wings. All this from an aircraft design so radical that the Air Ministry initially rejected it (who in their right mind would build an unarmed warplane?) and which was, when it finally went into production, built from wood. While the Lancaster was the heavy bomber par excellence, the Spitfire the alluring symbol of modernity, the Hurricane the real victor in the Battle of Britain, it was the adaptability of the Mosquito, a truly multi-role aircraft that made it the *best* British warplane of the Second World War.

Design history

Despite much theorising during the inter-war years, in 1939 the Air Ministry was still in a quandary about what it was looking for in bomber design. Nevertheless, in the minds of Air Ministry officials a bomber was generally slow-moving and lacking in manoeuvrability, heavily armed and

of metal construction for its own defence and combat worthiness. Its job was, as air theorists predicted, to ‘get through’ enemy defences and unleash its payload on targets in enemy territory.

What they were *not* looking for was a super-fast, wooden unarmed bomber. Yet in August 1936 the Air Ministry issued Specification P.13/36, formulated during the summer, for a quick (275mph) long-range (3000-mile) twin-engined medium bomber equipped with nose and rear turrets and with the capacity to deliver a substantial payload of 4000lb. This was the genesis of the Mosquito; however, its real origins can be found in the Air Ministry’s desire to combine the four roles envisaged – medium bomber, general reconnaissance, torpedo bomber and general purpose – into one basic design.

Mosquito Mk.XVI, ML963, 8K-K ‘King’ of No. 571 Squadron, pictured around September 1944. 571 Squadron were a Pathfinder Squadron which operated as part of No.8 Pathfinder Group. ML963 conducted over 30 successful trips to Berlin.

De Havilland were not convinced the specification would produce an effective aircraft and believed it could not be done on two Rolls-Royce Merlin engines. If it met the speed criterion the bomb load would have to be sacrificed, and vice versa. What was needed was either a compromise or a new way to approach the problem. Now the true genius of de Havilland and the Mosquito’s chief designer Eric Bishop came to the fore. If all defensive armaments were dispensed with and the aircraft constructed from wood, the airframe would be lightened. The Air Ministry was less than impressed with the suggestion, but the need for British rearmament was pressing because of the growing threat from Nazi Germany. The pressure intensified after the events of 1938 at Munich and inventive solutions were required.

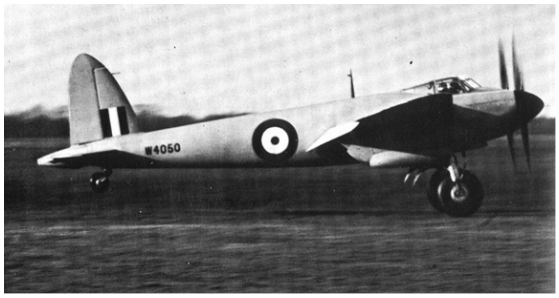
Throughout 1939 de Havilland continued to talk to the Air Ministry through Air Council Member for Research and Development Air Marshal Sir Wilfrid Freeman. Those conversations gained urgency with the outbreak of war. On 20 September de Havilland wrote to Freeman, outlining the idea for a wooden, unarmed twin-engined bomber, which was given the reference DH.98.

This proposal got things moving again, but the Air Ministry remained concerned about the DH.98's ability to continue flying faster than fighters. There was a subsidiary concern that a crew of just two would lead to unacceptable fatigue in the pilot and navigator, especially as the latter would take on bombing duties. The Ministry was still not convinced, clinging to the formula of a three-man crew for a bomber or using the de Havilland DH.98 proposal for a two-man light reconnaissance plane. There was still concern over the whole concept of an unarmed bomber. Nevertheless, models of DH.98 were sent for wind-tunnel testing – with favourable results. But there was really only one way for de Havilland to prove the versatility and suitability of the concept and that was to build a prototype. Freeman's support was crucial; without his firm commitment to the concept the Mosquito would likely never have been built.

British Aircraft designer Captain Geoffrey de Havilland is pictured with a model aeroplane in his office. de Havilland designed the Moth Biplane, Mosquito fighter/bomber and the Comet, the world's first jet airliner.

Further talks held on 29 December led to the issue of specification B.1/40. On New Year's Day 1940 de Havilland submitted drawings of the design that eventually morphed into Specification No.1/40/DH for the de

Havilland Light Reconnaissance Bomber Aeroplane, dated 1 March 1940. The same day a contract was issued for the construction of 50 airframes including a prototype. Even then, several times during 1940 the project came under threat from Lord Beaverbrook, then Minister for Aircraft Construction, who was far more interested in aircraft that would be coming into service in 1940 or early 1941. Once again the project benefited from Freeman's patronage and from some creative production estimates from de Havilland, which on 11 July 1940 promised 50 contracted aircraft by July 1941. This would be a remarkable timescale for any aircraft manufacturer, even without the bomb damage de Havilland suffered during the summer and autumn.



Mosquito prototype W4050 landing after a test flight on 10 January 1941. Four test flights were flown that day.

Nevertheless, construction on the first 'Wooden Wonder', W4050, continued apace. Stressed skin over a wooden frame left relatively large internal spaces, a key feature that gave the Mosquito adaptability in the configuration of armament and fuel tanks. The wings were constructed in one piece, the small fuselage in two, split down the centre to allow the fitting of internal equipment before the two were joined. Initial taxiing trials were held on 24 November 1940. The next day, after a short test hop off the runway, the chief test pilot, Geoffrey de Havilland, took off for a 30-minute flight. Further test flights showed off the Mosquito's fine handling, and a few teething troubles were soon tidied up. It had taken just 11 months to take W4050 from the drawing board into the air.

Once de Havilland was relatively happy with it, W4050 was sent to the Aeroplane and Armament Experimental Establishment at Boscombe Down for official handling trials. To many people's surprise, the trials showed the Mosquito to be around 20mph faster than a Spitfire, a remarkable feat and

one that finally grabbed the attention of the Air Ministry. It was summed up in typically understated British fashion by the AAEE Report 767 of 3 March: ‘The aeroplane is pleasant to fly’!

The first RAF formation to receive the Mosquito was No. 1 Photographic Reconnaissance (PR) unit. On 13 July W4051 arrived at the unit’s base at Benson, Oxfordshire. By 7 August W4051 had been joined by three more PR Mosquitos. The first Mosquito bomber, W4064, arrived at 105 Squadron on 15 November 1941. It made quite an impression. According to Sergeant Mike Carreck, ‘It came suddenly out of nowhere, inches above the hangars with a crackling thunderclap of twin Merlins.’ Carreck watched as ‘it was flung about the sky in a beyond-belief display for a bomber that could outperform a fighter’. Unsurprisingly, once the pilot, Geoffrey de Havilland, had landed, Carreck and others ‘pushed and shoved around this impossible dream of an aircraft … it was beautiful’. It was, he continued:

> …an arrogant beauty with a ‘job-to-do, get-out-of-my-way’ slim, sleek fuselage, high cocked ‘to-hell-with-you’ tail. It had awesome power on the leash in those huge engines and was eager on its undercarriage like a sprinter on the starting blocks who couldn’t wait to leap up and away.

‘Another great day in the history of 105 Squadron,’ the unit diary noted of this auspicious arrival, continuing somewhat laconically, ‘All crews watched with great enthusiasm the performance in the air. Even the Spitfire pilots of 152 Squadron were impressed’!

The difference between flying something like a Blenheim and flying the Mosquito was remarkable. Flight Lieutenant ‘George’ Parry flew the prototype on 25 November 1941: ‘After the Blenheim the Mosquito was unbelievable. The maximum recommended speed was 420mph indicated air speed, but at 20,000ft this was equivalent to 520mph.’ Sergeant John Clark, a navigator in 571 Squadron, described his first experience of taking off in a Mosquito thus: ‘The two Merlin engines took us by the seat of our pants and pulled us down the runway.’

It was the sheer speed of the Mosquito that thrilled her aircrew. Sergeant Pete Hardiman was an American pilot flying with the Royal Canadian Air Force, who now found himself in 139 Squadron. ‘It was a fantastic airplane,’ he recalled, ‘very fast; even with a full load we could reach

300mph. The cockpit was not designed for more ease of control, although everything was within easy reach. It was cramped, and to sit for several hours in one place like a crowded dentist's office was a bit much; but the thrill outshone any bad points.' The cockpit layout of the Mosquito was, in any case, integral to its success, for it created a special bond between the pilot and navigator, according to Flying Officer Derek Smith: 'In the bomber "Mossie" we sat side by side, almost shoulder to shoulder, sometimes for five or more hours… In the "Mossie", every move which was made was seen by the other, so maybe it served to weld us closer together as a unit.'

Mark II Mosquito armed with 4 x 20mm cannon and 4 x .303 Browning machine guns. The Mosquito combined the best features of the bomber and long-range fighter.

Operational history

W4066 was the first Mosquito bomber to enter RAF service, at Swanton Morley on 17 November 1941 with 105 Squadron. It was another six months before the aircraft fully entered the war, with a raid against Cologne by four Mosquitos on 31 May 1942. Things stepped up from then on, with

105 Squadron specialising in low-level, pin-point accurate bombing raids. Responding to information from the Norwegian resistance that a major meeting of Nazi and Quisling (Norwegian collaborators) would take place at the Gestapo HQ in Oslo in late September, the Norwegian government in exile in London sanctioned a raid on the city to target the building. Four Mosquitos, led by 'George' Parry, would undertake a round trip of 1100 miles, flying at an altitude of 50–100ft all the way across the North Sea to deliver 500lb bombs right onto the target. That is precisely what they did; four bombs entered the building, with three exploding. One Mosquito was shot down by a FW190. Parry was asked to speak about the raid on BBC radio:

> On Friday afternoon Quisling and I had an appointment in the same town. Quisling had a big crowd with him, I believe – it was one of his party rallies. I had only a little crowd – we were in four Mosquitos – and they gave us very short notice. But we were punctual.

Though it was but a small event in the maelstrom of the war, Parry had announced to the world that the RAF possessed a new weapon to take the fight to Germany.

At RAF Marham, 109 Squadron, the second to receive Mosquito bombers, formed up to test a number of radio bombing aids. The first was a radar device called Oboe which was operationally trialled on 20–21 December 1942 during an attack against the Dutch power station at Lutterade. Oboe was a success and was rolled out across Bomber Command; Mosquitos equipped with it were christened 'musical' Mosquitos. In the meantime, 105 and the third Mosquito squadron, 139 Squadron, began a precision air assault conducting over 100 raids during the first half of 1943. The accuracy of this bombing campaign, possible only thanks to the flying qualities of the Mosquito teamed up with Oboe, was further displayed on 27 May 1943 when 105 and 139 Squadrons attacked the Schott Glass Works and Zeiss Optical Instruments Works at Jena. Flying at low level over sea and land always made the trip interesting, recalled Wing Commander H. W. Reynolds of 139 Squadron: 'One sees such things as cyclists jumping off their cycles to have a look round to see what is coming. Children look up at us, then put their heads down and run as hard as they can.' Approaching the

target at high speed, Reynolds picked a tall building, releasing his bombs and clearing the building, but as he did so ‘the airscrew received a direct hit. There was a violent explosion in front of my eyes and I felt something tug at my hand and leg but took no notice of it for the time being.’ In a hail of tracer bullets Reynolds dodged and twisted, then was clear. Both his leg and his hand were bleeding. ‘After that one violent explosion it seemed a miracle that the aircraft could keep in the air,’ but, testament to the Mosquito’s robust frame, it did. Reynolds made it back to base. Of the 14 Mosquitos that had set off, three did not return and two more crashed attempting to land.

Despite these losses, the Mosquito had proved its worth, even to the pugnacious Air Marshal Arthur Harris who now realised the value of accurate pathfinders for his beloved heavy bombers. After the Jena raid, the B.IX Mosquito bombers of 105 Squadron with their Oboe radar and 139 Squadron with Gee-H (H2S) devices, were transferred to 8 Pathfinder Force Group. Their role was to lead the main bomber force and, using their on-board radar capabilities, find and mark targets for the following main bomber stream. They also participated in spoof raids, whereby the Mosquitos would attack, using 500lb bombs, target indicators (TI) and window (aluminium ‘chaff’ designed to confuse enemy radar), in order to mark targets and draw up enemy fighters before the main force. This would then benefit from illuminated targets and an enemy fighter force now back on the ground and unable to scramble.

Sergeant Charles Parker, a navigator, explained the process. Following on from the Pathfinder Force (PFF) who had dropped TIs, their job was to drop four 500lb bombs on the TIs. But before that Parker had to drop window. All this involved climbing down from the cockpit into the glass nose:

> Half crouching, I’d throw out the window, then switch on the Mk 14 automatic bomb-sight. On my knees now, I peered into the illuminated cross, shaped like a sword, the point to the front. The bomb-release cable in my right hand was like a bell-push. I gripped it and directed Pat [his pilot] on the intercom: ‘Right, right, left, steady, steady… Bombs gone!’

But that did not signify the end of the mission; the pilot now had to keep the Mosquito flying on the same vector for another 30 seconds so that the rear-

facing camera could photograph the exploding bombs. Frank Russell, an Oboe navigator in 109 Squadron, recalled, ‘The Mosquito was a good-looking aeroplane of very high performance. It seldom let you down and for the Oboe role it proved the ideal – there was no other aeroplane at our disposal that could have filled the bill.’

It was not just Harris who was impressed. In early 1944 Wing Commander Leonard Cheshire, now in command of 617 ‘Dam Busters’ Squadron, had lobbied for a Mosquito to be attached to his Lancaster squadron to serve in the Master Bomber role, identifying the target, marking it and continuing to direct the main bomber stream onto it. Cheshire used a Mosquito on 5–6 April to low-level mark an aircraft factory at Toulon and again on 10–11 April to mark a depot at St Cyr. On 18–19 April, Cheshire led a small Mosquito force to mark railway yards at Juvisy for 202 Lancasters to obliterate; the yards remained out of action until 1947. With its utility proven, 617 were provided with four Mosquitos. Cheshire convinced Bomber Command that the Mosquito was the best aircraft for low-level accurate marking, leading to the addition of a PFF to Group 5 as well as the PFF that had been created for Group 8. By May 1944 it was accepted practice for Oboe-carrying Mosquitos to mark targets for the heavies to drop their payloads. Cheshire was awarded the Victoria Cross in July 1944 for the remarkable achievement of flying more than 100 missions; the citation made specific reference to his enduring many minutes of ‘withering fire’ while marking a target in Munich on 24–25 April 1944.

Eventually 16 squadrons of Mosquitos would be available to Bomber Command, all equipped with the B.XVI Mosquito which benefited from a pressurised cockpit that allowed for high-altitude flying at up to 40,000ft. This version could also carry the 4000lb cookie and, with its range enhanced by external underwing fuel tanks, could drop it on Berlin in a so-called ‘milk run’ to the ‘big city’, while taking advantage of the Mosquito’s by now legendary speed to avoid enemy night fighters. Mosquitos were also used by Bomber Command in night intruder roles. Patrolling at low level for an hour or so above Luftwaffe bases, they prevented the enemy from interfering with the main bomber stream far overhead. The flexibility and adaptability of the Mosquito provided it with another role, flying meteorological ‘Pampas’ runs over Germany to determine whether the weather conditions were likely to affect follow-on bombing attacks and

therefore whether the PFF should use sky or ground TIs. In early 1944 the Light Night Striking Force (LNSF) was established by Bomber Command to exploit the combination of reach, accuracy, speed and payload of the Mosquito in attacking discrete targets such as rail links, airfields and, as the Oslo raid had already shown, Gestapo buildings.

Bombing of the Shellhus (Shell House) the Gestapo headquarters in Copenhagen during Operation Carthage.

The fighter-bomber Mosquitos of the 2nd Tactical Air Force, which had begun its own intruder campaign against targets in Germany and the occupied territories in 1943, were also busy with precision attacks. In Amiens Prison the Germans held hundreds of French resistance fighters; of whom 12 would be executed on 19 February 1944. With the French resistance providing detailed intelligence, the plan behind Operation Jericho was to blow open the 3ft-thick, 20ft-high prison walls to allow the prisoners to escape. In advance of the raid, a model of the prison was built, allowing the Mosquito crews the opportunity to assess the attacks from their usual low-level perspective to identify landmarks, flak guns and precise targets. The raid would be carried out by five Mossies of 464 RAAF Squadron and six from 487 RNZAF Squadron. A follow-up wave was detailed to obliterate the prison if the first two squadrons failed. On 18 February in blizzard conditions 19 Mosquitos took off from RAF Hunsdon with Typhoons providing top cover. The offensive was a startling success, with the walls breached and doors blown off by the first bombs. In the resulting confusion 150 prisoners escaped; 102 were killed by the bombing. The French resistance pointed out that it was far more honourable to be killed by

an RAF bomb than by a Gestapo firing squad. The cost was three Mosquitos damaged and two men lost, including the leader of the raid, Group Captain Percy Pickard.

Further raids followed, including Operation Carthage on 21 March 1945 against the Gestapo HQ in the Shellhus building, Copenhagen, carried out by 21 Squadron, 464 RAAF Squadron and 487 RNZAF Squadron. The main raid was a success, but a Mosquito hit a lamp post before crashing into a Catholic school. Follow-on waves then mistakenly pounded this target, killing 86 children and 10 nuns along with teachers and other civilians. Even further afield, in 1943 the decision was made to send 23 Squadron to assist in the defence of Malta. Under the command of Wing-Commander Peter Wykeham-Barnes the unit maintained a high tempo of operations, carrying out 184 sorties (including 73 intruder patrols and 82 ground attack missions) during its first month. The squadron's new nickname, the 'Malta Pirates', was well earned.

The build-up to Operation Overlord, the Allied invasion of Normandy, saw Mosquitos carry out further precision raids alongside other actions to support the invasion plan. Mossies flew fighter-bomber patrols, able to engage enemy aircraft while possessing the armament to attack opportunity targets on the ground. On the night of the invasion, 5–6 June 1944, all six Mosquito squadrons in the 2nd TAF flew cover patrols to prevent Luftwaffe interdiction of the air and sea invasion. 418 Squadron had one of the most dangerous 'flak bait' missions. The squadron's task was to draw enemy ground fire away from the transport planes carrying American Paratroopers of the 82nd and 101st Airborne Divisions landing on the Cherbourg Peninsula behind Utah beach. Once Allied forces were ashore, Mosquitos continued to provide support to the overall operation, attacking German barracks at Poitiers on 1 August and SS barracks at Égletons on 18 August, and sending millions of tons of precious German fuel up in flames at a petrol dump near Nancy on 31 August. Between 5 June and 11 July R. W. Smith, a Mossie pilot in 613 Squadron, flew 17 night-time operational sorties over Normandy in the fighter-bomber role 'attacking roads, bridges, marshalling yards and any lights or movements seen' and from 6 July 'bridges, railways, trains and transport'. Such harrying attacks, especially against targets such as these, were critical as, in the last year of the war, the greatest limiting factor in German operations in the west was an

increasingly tenuous supply of fuel. Operationally, destroying transport links made it increasingly difficult for the German forces to move their troops towards Normandy and, as a consequence, and one in which the Mosquito played a key role, the Allies could bring greater forces to bear in order to secure their position in Normandy.

An attack by Mosquitos on enemy cargo in a Norwegian fjord, 1945.

Typical was an attack on the transport hub at Rouen, where by late August 1944 German troops were retreating across the River Seine. 305 Polish Squadron was tasked with making this even more difficult for the German forces, as recalled by Flight Lieutenant Eric ‘Tommy’ Atkins. On 25–26 August they had been hunting for German trains carrying V-1 and V-2 rockets when they were bounced by a German fighter. Turning tightly, Atkins returned fire and sped for home. It was a salient reminder for Mosquito pilots that while the Luftwaffe was a desperately wounded beast, it still possessed a nasty bite.

The next night their target was Rouen: ‘The briefing was fairly simple,’ recalled Atkins; ‘we had to tour the Rouen-Gisors-Dieppe area and bomb and strafe anything that moved, and in particular, the mass of vehicles trying to retreat across the Seine.’ Flying at 800ft Atkins thought that with ‘so many Mosquitos in the same area we had the further concern of avoiding each other!’ With German vehicles on fire, picking out the convoy was not a problem; Atkins ‘bombed by the light of our flares and then turned around to gun the area again – the smoke rising up seemed to fill the cockpit and warned us that we were too low in the darkness. Our deed done, we turned for home. At that moment, a dark shape dived in front of us,

missing us by inches. “Another damned Mosquito!” ’ retorted his navigator, Flight Lieutenant Jurek Majer. Returning to base at RAF Lasham, Atkins’s Mosquito was re-fuelled and re-armed ready for his second mission of the night, targeting a road junction near Rouen stuffed with German vehicles upon which Atkins unleashed all his ammunition and bombs. As they returned to Lasham again, Jurek asked him if he fancied a ‘hat-trick’ and with the Mosquito once more good to go, he set off for Rouen where they found and bombed a goods train before strafing the city and setting a course for home.

Mosquitos found themselves in other roles as well. On 1 April 1943, 618 Squadron was formed as part of Coastal Command to deliver Barnes Wallis’s Highball mine against the *Tirpitz* and other German shipping targets. To allow the Mosquito to take Highball, the plane’s bomb bay doors were removed. The Mosquito operation against the *Tirpitz* never took place and the aircraft were given another role as Mosquito ‘Tsetse’s, each with a 57mm Molins cannon that fired a six-pounder shell to attack U-boats. Warrant Officer Jim Hoyle recalled his first experience of the cannon: ‘…a hell of a bang’ as a 30ft flame leapt from the nose of the Mosquito ‘…at the same time, the airspeed indicator went back to zero and such was the power of the recoil that it did in fact feel as though the plane had been literally stopped in its tracks.’ The fighter bombers of RAF Coastal Command were also used for anti-shipping and anti-submarine duties. Equipped with four 20mm cannon and four .303 Browning machine guns in the nose and four rockets under each wing, Coastal Command Mossies eventually accounted for 10 confirmed U-boat kills.

In the Mosquito’s photo reconnaissance (PR) role, it was 540 Squadron’s photographs of the German rocket research facility at Peenemünde that revealed the existence of the V-1 programme. Mosquitos would play an integral role in attacking the sites of Hitler’s wonder weapons. Compared with the heavy bombers which averaged upwards of 165 tons of bombs to destroy one of the sites, the Mosquito used on average just under 40 tons. The appearance of V-1 rockets over southern England came as a surprise to men like Flying Officer Schultz of 605 Squadron. He was the first Mosquito pilot to encounter the threat on the night of 14–15 June 1944 when he spotted what he later called a ‘queer aircraft’ flying towards England. Flying at extreme speed to shoot it down, he passed through the resulting

debris cloud, ripping most of the skin off his Mosquito. When equipped with guns, the Mosquito could still be deadly in the PR role. Sergeant Pete Hardiman recalled, ‘During the photo run I noticed an aircraft off the port side with German crosses.’ His navigator warned him not to mess with the Me110 night fighter, so Hardiman throttled back and slipped in behind it. ‘Then I recalled I was flying a MkVI.I, checked the gun-sight and saw his wingspan filling the outer ring, so I fired all guns. He blew up in a brilliant flash … we returned to base to find the paint removed from the entire front of the aircraft, including props, and the radiator intakes full of debris.’

Perhaps the most famous Mosquito casualty was the commander of 617 ‘Dam Busters’ Squadron during Operation Chastise, Wing Commander Guy Gibson. Wallace Gaunt, a Mosquito navigator in 627 Squadron, thought Gibson brave and professional, but when he walked into 627’s mess one night ‘everybody was talking, playing liar-dice, drinking, etc, so he called out, “Don’t you know who I am?” He got very annoyed as he had expected everyone to stand up and cheer him. In the end he was de-bagged and put outside.’ Gibson talked the commanding officer of 627 Squadron into letting him fly a Mosquito on a raid; he ended up flying the aircraft Gaunt had been supposed to be in. Gibson crashed on the return journey over the Netherlands and was killed.

By the last few months of the war, Mosquitos were regularly operating deep into Germany, with those of the LNSF conducting nearly 4000 sorties and losing 57 aircraft between January and May 1945. Berlin was bombed on 61 consecutive nights. On the night of 21–22 March 1945, 138 attacked Berlin with the loss of only one aircraft. On 3–4 April, 95 made the journey, and on 13–14 April, 29 did so, including 608 Squadron’s Flight Lieutenant George Nunn. His experience was a salient reminder that the Allies could not operate with impunity. Flying high at 27,000ft and fast at 310mph, his navigator, Pilot Officer Harry Harris, recalled, ‘we had no fear of enemy fighters as only jets could get at us and we thought they were few and far between’. After diving, during which they were coned by searchlights, they delivered the 4000lb ‘cookie’. Still illuminated and turning for home, Harris called out, ‘Fighter!’ Now climbing, Harris remarked that one of their aircraft was flying behind them with its navigation lights on and they were gaining very fast. ‘I then knew,’ Harris remembered, ‘it was not one of ours but the dreaded German jet.’ Nunn dived as the enemy strafed his

Mosquito, missing the cockpit by inches, and rolling upside down. Harris found himself up against the roof, as he had not been strapped into the bomb-aiming position in the nose. At one point he found himself ‘floating in the cockpit’ as Nunn, temporarily blinded by a searchlight, manoeuvred the Mosquito. The Mosquito dived down to 2000ft before Nunn managed to get back into a controlled flight. An ME262 had shot their fin and rudder. ‘We were minus half the tail,’ Nunn recollected, ‘but this didn’t affect the flying qualities of the aircraft.’ On 2 May 1945, Mosquitos of 608 Squadron undertook Bomber Command’s last raid of the war, dropping bombs onto the port town of Kiel.

The end of the war did not signal the end of the Mosquito story. The RAF continued to use Mosquitos in the PR role until they were replaced by Canberras in 1953. In terms of RAF active operations, the last Mosquitos to see action over ‘enemy’ territory were the PR variants of 81 Squadron which flew over 4000 sorties during the Malayan Emergency. In the UK, Mossies were used into the 1960s, for testing ground radar and for towing target drogues. Overseas the Mosquito still had a military role to play. Israel received smuggled Mosquitos in 1948–49, and further aircraft sold by France in 1950. During the 1956 Suez Crisis, these Mosquitos were deployed by the Israelis in PR, fighter-bomber and night-fighting roles. In 1947 China was sold around 180 airframes by Canada.

Conceived as an unarmed wooden-composite bomber, the Mosquito proved to be the most effective aircraft in that role – and a very effective aircraft in just about any role. In terms of construction and maintenance the manpower cost of the Lancaster was 2.8 times that of the Mosquito. In 1943 and early 1944 the Mosquito dropped 101 tons of bombs for every aircrew missing, while the Lancaster managed only 10 tons for every missing aircrew. During 1944 the Mosquito made 92 sorties per write-off, compared with the Lancaster’s 28 sorties per write-off. Once equipped with the 4000lb bomb, Mosquitos could drop four-and-a-half times the weight of bombs as for the equivalent investment in the Lancaster. The Air Ministry concluded that, ‘Owing to its low casualty rate, the Mosquito bomber is, ton for ton dropped, nearly three times as economical in aircraft as the Heavy Bomber and ten times as economical in aircrew personnel.’ De Havilland had been more than justified in his visionary concept, which had resulted in the construction of 7781 Mosquitos. Of that number around 30 survive

today, with seven currently on display in the UK and with others displayed in Norway, South Africa, Australia, Belgium, Canada, New Zealand and the United States. Only two Mosquitos are airworthy, KA114 in the United States and VR796 in Canada.

Wing Commander John de L. Wooldridge of 105 Squadron got to the heart of the matter for those who flew in a Mosquito:

> The Mosquito bomber is, in every way, an outstanding aeroplane – easy to fly, highly manoeuvrable, fast and completely free from vices of any sort. From our point of view, it has a further quality, a highly important one in wartime – and that is an extraordinary capacity for taking a knocking about.

So much so that during the Second World War German night fighter command would allow any of its pilots who managed to down a Mosquito to claim two kills rather than the standard one.

Significant Mosquito Variants

Given the flexibility of the airframe for adaption, many Mosquitos were re-roled during or after production, for instance conversion of bomber configuration to fighter configuration.

Name	Engines	
PR.1	2 × Merlin 21	
F.II	2 × Merlin 21 or 23	4 × .303 in nose, 4 × 20mm cannon fuselage belly
B.IV	2 × Merlin 21 or 23	4 × 500lb bombs or a 4000lb bomb
NF.II	2 × Merlin 21 or 23	4 × .303 in nose, 4 × 20mm cannon fuselage belly, radar
FB.VI	2 × Merlin 22, 23, or 25	4 × .303 in nose, 4 × 20mm cannon fuselage belly, 2 × 500lb bomb or 8 × 60lb RP
FB.XVIII Tsetse	2 × Merlin 22, 23, or 25	2 or 4 × .303 in nose, 1 × Molins 6pd AT cannon under nose
Sea Mosquito TR.33	2 × Merlin 25	4 × 20mm cannon, 2 × 500lb bombs, 2 × 500lb bombs under wing or 8 × 60lb RP, under fuselage torpedo

CHAPTER 1
Design and trials

SECRET.

DRAFT.

Air Staff Requirements for a twin engined Medium Bomber landplane. Specification P.13/36.

1. The Air Staff require a twin-engined Medium Bomber for world wide use. It should be an aircraft that can exploit the alternatives between long range and very heavy bomb load which is made possible by catapult launching in a heavily loaded condition.

During all operations it is necessary to reduce the time spent over enemy territory to a minimum, therefore the highest possible cruising speed is necessary. Load carrying capacity and range with adequate facilities for an interchange of petrol and bomb load are of primary importance and all round defence is essential. In order to ensure that the all round defence is adequate power operated gun turrets are to be located in the nose and tail. The aircraft must be suitable for operation by day and by night at home and abroad and must possess the best possible bomb aiming and navigational facilities. Since this aircraft is to be used at home and abroad it must possess good facilities for maintenance in the open.

It appears that there is a possibility of combining the Medium Bomber, the General Reconnaissance, the General Purpose and the Torpedo Bomber Classes in one basic design which can be adapted at some stage in its construction to each specific role. The following requirements are issued with this end in view. It is not intended that the type as a whole shall be able to carry out each of the four roles enumerated above. For example the

general reconnaissance type will not be required to fulfil the role of the torpedo bomber.

2. Performance.

(i) Speed:- The speed at 15, 000 feet must be not less than 25 m.p.h. at two-thirds maximum engine power at maximum cruising R.P.M.

(ii) Range:-

(a) At Normal loading:- (500 yds. take off)

The range at 15,000 feet must be not less than 1,000 miles at two-thirds maximum engine power at maximum cruising R.P.M. at normal loading (including 1,500 lb. bombs.) after 1/2 hr. at maximum power at sea level.

(b) Increased load:- (700 yds. take off).

The range at 15,000 feet must be not less than 2,000 miles at two-thirds maximum power at maximum cruising R.P.M. with not less than 2,000 lb. bombs after 1/2 hr. at maximum power at sea level.

(c) Maximum load:- (accelerated take off).

The range at 15,000 feet must be not less then 3,000 miles at two-thirds maximum power at maximum cruising R.P.M. with not less than 3,000 lb. bombs after 1/2 hr. at maximum power at sea level.

N.B. Under condition (c) above it is hoped that a range of at least 1800 miles will be attained when carrying the maximum possible bomb load i.e. 8,000 lbs. The maximum range for this aircraft should be not less than 3,000 miles.

(iii) Service Ceiling:-

The service ceiling should be not less than 26,000 feet at normal loading. The aircraft, at normal loading must be capable of flying level at 10,000 feet with one engine stopped.

(iv) Take off and Landing:-

Reasonable landing and take off conditions for an average sized aerodrome are required. The following conditions are given as a guide to what is considered reasonable. When taking off at normal loading the aircraft should clear a 50 foot obstacle in not more than 500 yards. When landing at normal loading the aircraft

should come to rest in 500 yards after coming in over a 50 foot obstacle. The landing run should not exceed 250 yards.

3. Crew.

Provision is to be made for a crew of 4 as follows:-

2 Pilots. One of the pilots to act as navigator bomb aimer and front gunner.

1 W/T operator.

1 Air Gunner.

Accommodation must be provided for one additional Observer who will act as relief W/T operator or air gunner on long flights.

4. Armament.

(i) Forward:- Two guns in a power operated turret under the control of the second pilot, who must be able to fire from a seated position. Each gun must be provided with not less than 1,000 rounds of ammunition and must cover the following arcs:-

Azimuth:- Wing tip to wing tip or airscrew disc to airscrew disc and not less than 180º.

Depression:- not less than 45°.

Elevation:- not less than 45°.

(ii) Tails:- Four guns in a power operated turret, under the control of the air gunner who must be able to fire from a seated position. It is essential that access to the tail turret is provided from within the fuselage. Each gun must be provided with 1,000 rounds of ammunition. It is desirable that 1,500 rounds be provided if this can conveniently be arranged. The guns must cover the following arcs:-

Azimuth:- not less than 180°.

Depression:- not less than 45°.

Elevation:- not less than 60°.

A reserve of 6,000 rounds (or 4,000 rounds if 1,500 are provided for each gun at the tail position) is to be stowed in such a manner that extra belts can quickly be fed to the guns at the tail position. The reserve ammunition to be alternative load.

NOTE: Any satisfactory alternative scheme for remote control of the guns which will help towards minimizing the resistance of the turrets will be considered.

5. Bombs:-

Provision is to be made for carrying a maximum bomb load of 8,000 lbs. Which may be up in any of the following forms:-

(a) 16 × 250 lb. G.P. or A.S. or S.A.P. or "B" or L.C. or S.C.1. apparatus (4,000 lbs.).

Or

(b) 16–500 lb. G.P. or A.S. or S.A.P.

Or

(c) 4–2,000 lb. A.P. or.

Or

(d) 2–1,900 lb. Torpedoes.
(diameter 18" length 18'2 ½" with a special tail portion, particulars of which will be supplied).

Internal horizontal stowage for bombs in superimposed tiers or some equivalent arrangement will be required.

Two light series bomb carriers, capable of being reloaded in the air, are to be provided for carrying practice bombs. They are to be easily detachable so as not to interfere with the war role or the aircraft. Provision for carrying 16 practice bombs in the aircraft is to be provided.

It is realized that conversion from the universal carrier to the 2,000 lbs. Carrier may take some time but provision is to be made for carrying out the work as quickly as possible.

Further details of the bomb load, including rate of release, are being prepared and will be issued separately.

6. View.

The best possible all round view for pilot, navigator and bomb aimer and air gunner is to be provided but this is secondary to performance. A good view backwards for the pilot or someone standing beside him is important.

A good view for formation flying is required both for formation leader and flanking aircraft as well as for landings at night.

7. Manoeuvrability:-

A high degree of manoeuvrability is not essential but the aircraft must be sufficiently manoeuvrable at high speeds for dive bombing. The controls must be positive and effective in order to provide a stable bombing platform.

8. Equipment.

The following are required:-

(I) Full night flying equipment including wing landing lights and station keeping lights.

(II) W/T, R/T, D/F and internal communication between crew stations.

(III) Oxygen for a crew of five for 5 hours, with provision to increase to 10 hours. The increase to be considered as alternative load.

(IV) Camera.

(V) Automatic controls.

(VI) Cockpit heating at all crew stations.

(VII) Provision for anti-icing equipment.

(VIII) Emergency dinghy for crew of four with appropriate marine distress signals.

(IX) Full flotation gear. (G. R. Class only).

(X) Stowage for desert equipment.

(XI) Stowage for 20 flame floats and 12 aluminum dust markers as alternative load.

9. Special Features.

(i) Navigation is to be done in the vicinity of the pilot's station. Bomb aiming is to be done from the front station which is to be so arranged that the bomb aimer can work from a seated position.

(ii) Launching tubes will be required for 4" training flares (which is also used as a forced landing flare), and 4.5" and 5.5" reconnaissance flares. The flares may be regarded as alternative load. Stowage must be provided for 4 training flares and 12 reconnaissance flares.

(iii) Tropical engine cooling is to be incorporated or made easily attachable.

(iv) The fuselage is to be so constructed that any member of the crew can move from his usual station to any other station.

(v) Attention must be paid in design to good ventilation at all crew stations and it is desirable that sun proof blinds are fitted above all crew stations for use in the tropics.

(vi) Provision is to be made for fitting a blind flying hood to the pilot's seat.

(vii) Suitable lugs are to be provided to which cables can be attached for moving the aircraft about by tractors when on the ground.

(viii) The design, construction and material of the aircraft is to be such as to facilitate production in quantity. Wherever possible standardised parts and fittings, including A.G.S. parts which can be obtained in quantity production are to be used.

(ix) The following feature is required in the General purpose class only. A means whereby bulky packages, which will not fit into the standard supply dropping container, can be dropped.

(x) In view of the fact that the aircraft may be in the air for periods of 10 to 14 hours, it is desirable that attention be paid to sound-proofing the pilot's cabin.

(xi) A lavatory is to be provided for use of the crew.

(xii) Consideration is to be given in design for fitting a light removable form of seating for the maximum number of personnel that can be accommodated within the fuselage when the aircraft is being used for reinforcing overseas Commands.

(xiii) Particular attention is to be paid to providing facilities for changing engines in the shortest possible time.

APPENDIX A.
SECRET.

TWIN ENGINED MEDIUM BOMBER LANDPLANE.
(SPECIFICATION P.13/36.)

Combining Medium Bomber, General Reconnaissance, General Purpose and Torpedo Bomber requirements and stressed for Catapult launching.

CASE I.

Span 69 ft. 2 Perseus engines.

(a) Normal load (16,000 lbs.) not more than 500 yds. take off.	(b) Overloaded (18,800 lbs.) 700 yds. take off.	(c) Maximum Overloaded (24,000 lbs.) accelerated take off.
Top speed. 254 m.p.h.	Top speed. 253 m.p.h.	Top speed. 245 m.p.h.
Cruising. 220 m.p.h.	Cruising. 215 m.p.h.	Cruising. 205 m.p.h.
Range. 1000 miles with 1500 lb. bombs.	Range. 2000 m. with 1650 lb. bombs.	Range. 3000 m. with 4000 lb. bombs.
	” 1500 m. ” 3000 ” ”	” 2000 ” ” 6400 ” ”
	” 1000 m. ” 4200 ” ”	” 1400 ” ” 8000 ” ”
	or:-	
	with 800 yds. take off.	
	Range. 3000 m. with 320 lbs. bombs.	
	” 2500 ” ” 1500 ” ”	
	” 2000 ” ” 2800 ” ”	
	” 1000 ” ” 5300 ” ”	

CASE II.

Span 78 ft. 2 Hercules 1 SM engine.

(a) Normal load (20,500 lbs.) not more than 500 yards take off.	(b) Overloaded (25,400 lbs.) 700 yds. take off.	(c) Overloaded (30,700 lbs.) accelerated take off.
Top speed. 292 m.p.h.	Top speed. 288 m.p.h.	Top speed. 282 m.p.h.
Cruising. 250 m.p.h.	Cruising. 245 m.p.h.	Cruising. 237 m.p.h.
Range. 1000 m. with 1500 lb. bombs.	Range. 2500 m. with 250 lb. bombs.	Range. 3000 m. with 3,60 lb. bombs.
	” 2000 ” ” 2000 ” ”	” 2500 ” ” 5500 ” ”
	” 1500 ” ” 3800 ” ”	” 2000 ” ” 7250 ” ”
	” 1000 ” ” 5500 ” ”	” 1800 ” ” 8000 ” ”

SECRET.

TWIN ENGINED MEDIUM BOMBER LANDPLANE. (SPECIFICATION P.13/36.) FIRST DRAFT OF THE PREVIOUS TABLE WITH ORIGINAL SPECIFICATION FOR SPEEDS FOR THE PERSEUS ENGINES.

Combining Medium Bomber, General Reconnaissance, General Purpose and Torpedo Bomber requirements and stressed for Catapult launching.

CASE I.

Span 69 ft. 2 Perseus engines.

(a) Normal load (16,000 lbs.) 500 yds. take off.	(b) Overloaded (18,800 lbs.) 700 yds. take off.	(c) Maximum Overloaded (24,000 lbs.) accelerated take off.
Top speed. 254 m.p.h.	Top speed. 253 m.p.h.	Top speed. 245 m.p.h.
Cruising. 220 m.p.h.	Cruising. 220 m.p.h.	Cruising. 220 m.p.h.
Range. 1000 miles with 1500 lb. bombs.	Range. 2000 m. with 1650 lb. bombs.	Range. 3000 m. with 4000 lb. bombs.
	” 1500 m. ” 3000 ” ”	” 2000 ” ” 6400 ” ”
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	or:-	
	with 800 yds. take off.	
	Range. 3000 m. with 320 lbs. bombs.	
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	” 2000 ” ” 2000 ” ”	” 2500 ” ” 5500 ” ”
	” 1500 ” ” 3800 ” ”	” 2000 ” ” 7250 ” ”
	” 1000 ” ” 5500 ” ”	” 1800 ” ” 8000 ” ”

20th September 1939.

Air Marshal Sir Wilfrid R. Freeman,
K.C.D., D.G.O., M.C.,
Air Member for Development and Production,
Air Ministry,
Berkeley Square House,
Berkeley Square,
LONDON W.I.

Dear Freeman,

We have stopped all civil design and want to put our whole design staff on to war work. From former conversations with you, and using the experience we have gained in very quickly producing types which have to compete with others from all over the world, we believe that we could produce a twin engine bomber which would have a performance so outstanding that little defensive equipment would be needed.

This would employ the well tried out methods of design and construction used in the "COMET" and the "ALBATROSS" and, being of wood or composite construction, would not encroach on the labour and material used in expanding the R.A.F. It is specially suited to really high speeds because all surfaces are smooth, free from rivets, overlapped plates and undulations. It also lends itself to very rapid initial and subsequent production.

The brief specification would be as follows:

Rolls Royce Merlin 100 octane engines.

1,500 miles range.

Two 500 lb. or six 250 lb. bombs.

Pilot and observer.

Maximum speed 405 m.p.h. at 20,000 feet.

Cruise on weak mixture 320 m.p.h.

Take-off would be well within the extended limit allowed for bombers.

Landing without fuel and bombs would be on a wing loading of 30 lbs. per sq. ft.

The principal objects which would be achieved by this type are shortly as follows:-

1. Its production would absorb a class of labour and material which is outside and additional to that used in the main aircraft production.

2. The smallest possible call would be made on “Embodiment Loan” stuff etc., owing to its simplicity and to the fact that it relies mainly on performance for its defence.
3. It makes use of a design staff which has had much experience in very quickly producing aircraft types to meet specific and competitive needs.
4. The wood or composite construction allows of the minimum time and man-hours being spent on making jigs etc.
5. The existence of a type of bomber having the highest performance possible and capable within a year of going into production forms a kind of insurance against surprises emanating from the enemy’s design resources. If a prototype were undergoing trials in, say, nine months, without detracting from the main production plans, it would be a platform for future plans, the value of which can hardly be exaggerated.
6. This type of construction permits mixed grades of timber to be used with safety.

We have arranged a provincial location and are moving our design staff to it. We should be able, therefore, to start on this project forthwith.

We feel such confidence that the existence of this type or a closely similar one will be a valuable asset in a year’s time that we very much hope you will be able to give it your support. If this is the case we should have to discuss the minimum equipment with the people concerned.

Yours sincerely,
[signed, G De Havilland]

P.S. I am anxious to get this preliminary proposal in to you without delay, but will just add that it has been based on the availability of Merlin engines. Were it possible to use Sabres the same performance and range could be obtained with 4,000 lbs. of bombs, crew of three and two guns.

2 July 1945, Sawbridgeworth, Hertfordshire: workers assembling ‘Mosquito’ fuselages at a factory

The Mosquito fuselage was built in two halves allowing for the fitting of internal workings, such as electronics, before the two halves were joined together.

The Mosquito was designed with a one-piece wing, the wooden spars and ribs are clearly visible.

Draft for De Havilland.

OPERATIONAL REQUIREMENTS FOR HIGH SPEED LIGHT RECONNAISSANCE AEROPLANE.

1. The Air Ministry is desirous of exploiting the development of a high speed light reconnaissance aeroplane.

The aeroplane is primarily to be suitable for the duties of long distance high and low altitude reconnaissance but it is desirable that it should be capable of easy conversion to operate either as a bomber or as a fighter, so long as this does not affect its suitability for the primary role.

2. The all-up weight of the aeroplane is to be kept as low as possible and a type not greatly in excess of 20,000 lb. flying weight when operating as a bomber is visualised.

3. The size of the aeroplane is to be restricted in order to facilitate rapidity of manufacture, structural simplicity and low first cost and these items are considered to be of the greatest importance. Wooden or composite construction, employing materials and classes of labour which are not used to any great extent at present on standard aeroplanes for the Royal Air Force would be a great advantage.

4. To attain the requirements within the weight limitation, a restriction, or even total elimination, of defensive armament is proposed. As a result a high performance both as regards maximum speed and climb is essential, in order that “evading tactics” may be adopted as a defence against attack.

5. In order to minimise the limitations imposed on the performance by the take off condition, new experimental features will be welcomed.

Performance.

6. Speed.

The maximum speed shall be as high as possible and not less than 400 miles per hour at 18,000 ft. The cruising speed at maximum economical cruising power shall not be less than 360 miles per hour at 20,000 ft.

7. Range.

The range, with normal reconnaissance load shall be 1,500 miles at maximum economical cruising power after an allowance of 50 minutes at the same power. Tankage, however, shall be provided for a range of 2,000 miles at maximum economic cruising power (after 50 minutes allowance) when carrying 1,000 lb. of bombs.

8. Take-off.

When taking-off from a grass aerodrome, with overload, i.e. when carrying 1,000 lb. of bombs and fuel for 2,000 miles, the aeroplane shall be capable of crossing a 50 ft. screen within a distance of 900 yards from rest in still air.

9. Landing.

When landing at reconnaissance load, but with fuel for 500 miles only, the aeroplane must be capable of coming to rest within 700 yards after crossing a 50 ft. screen in still air conditions.

10. Armament.

Provision shall be made for carrying the following types of bombs which will be treated as alternative overload.

2 × 500 lb. S.A.P., or G.P.

4 × 250 lb. S.A.P., or G.P.

2 × Small bomb containers, Plus 2 × 250 lb. S.A.P., or G.P. 1 × 1000 lb. G.P.

Standard types of bomb carriers and loading winches should be employed.

11. Alternative Gun Armament.

Consideration should be given to the possibility of providing a battery of 4 x 20 m.m. cannons as alternative to bomb load. 3 x 60 round drums of ammunition are to be provided for each cannon, with facilities for reloading. Adequate sighting arrangements are to be provided for the pilot.

The change over from the primary reconnaissance role to either fighter or bomber shall be as simple as possible and must be capable of being carried out rapidly by Squadrons in the field.

12. Crew.

Provision is to be made for a crew of 3 composed as follows:-

2 Pilots – one of whom will perform the duties of Navigator and Bomb Aimer.

1 Wireless Operator.

In view of the necessity for evasive tactics against fighters, it is essential that the pilot should have the best possible all-round view and in particular of aircraft attacking from the rear. If this cannot be obtained without considerable sacrifice of performance, the Wireless Operator shall be so positioned that he can act as look-out for attack from the rear.

13. Bomb Aimer's Position.

The best possible view, forward and downward, is required for the bomb aimer. The definition of the bomb aimer's view requirement is as follows:-

The bomb sight, including the supporting bracket, is combined in a cube of side 17". The optical centre is 3" above the centre of the cube. In range the view required is from 95º forward of the vertical to 6º past the vertical and optically clear and flat glass is required up to 75º with no interference from structural members. The remainder of the sighting angle is for run-up view. On azimuth, the view is to be to an angle of 70º on either side of the fore and aft line of the aeroplane, of which only 25º need to be through optically perfect plans. The maximum distance of the eye from the optical centre is 12". Head room to permit this eye position should be provided over the whole field of view.

The bomb aimer is to be provided with all selector, fusing and distributor switches. The pilot shall have jettison and firing switches only. Provision is to be made for installing either the centre setting bomb sight Mark X.

Adequate provision shall be made for cleaning the bomb sighting window.

14. Protection of Crew.

Protection is required for the crew against .303 armour piercing ammunition at a range of 200 yards from astern to any angle to the aeroplane centre line up to 10º. This protection may be given by armour plate or by a system of deflector plates. Armour should be designed so that plates damaged in action can be easily replaced or repaired.

15. Protection of Tanks.

At least 50% of the fuel tankage is to be protected against .303 fire, preferably by an approved form of Self-Sealing protection.

Other Features.

16. Emergency Exits.

Special attention is to be given to the provision of exits for escape by parachute at high aircraft speeds and these exits are to be designed so that escaping personnel are ejected below and clear of the aircraft structure. Readily accessible exits are to be provided for escape by inflatable dinghy in the event of an emergency landing on the sea.

17. Jettisoning.

Provision is to be made for jettisoning the whole of the bomb and fuel load. The fuel jettisoning is to be under the control of the pilot at all stages of the discharge, so that if necessary only a part of the fuel load need be jettisoned. The time to jettison the whole contents of the tanks should not exceed 2 minutes.

18. Stability.

The aeroplane should provide a steady platform for bomb aiming and for obtaining sextant observation. It should be stable about all three axes and free from periodic oscillations. Trimming adjustments during flight should be possible about all three axes.

19. Heating and Ventilation.

Adequate heating and ventilation is required at all stations. The heating system should employ waste heat from the engine and it is most important that every precaution is taken to exclude draughts. In addition the use of wood or plastics should be considered where control points come into contact with the hands or feet of the crew.

21. De-icing.

Approved forms of de-icing equipment shall be provided for the airscrews and carburettors. The wings, tail plane and fins shall be suitable for the paste method of de-icing.

22. Sound-Proofing.

The noise level at crew stations should not rise above the level at which inter-communication equipment will work satisfactorily.

23. Buoyancy.

It is necessary that the aircraft should be capable of remaining afloat in the event of an emergency landing on water. It is hoped that the buoyancy arrangements can be kept simple and of a form which will not be detrimental either to performance or simple production. The buoyancy arrangements should provide 30% excess buoyancy when all fuel and bombs have been jettisoned.

Equipment.

24. Flying.

(i) Full night flying equipment, including Exhaust Flame Dampers.

(ii) Blind Landing Equipment (Provision for).

General.

(i) Tail Drift Sight.

(ii) Limited pyrotechnics.

(iii) Oxygen for the crew of 3 for 5 hours.

(iv) W/T.

(v) Electrical Inter-communication system.

(vi) Abandon Aircraft Signal.

(vii) Photographic. The best possible provision shall be made for taking simultaneous oblique and vertical photographs by a battery of 3 P.24 cameras, 2 of which will be oblique, the other vertical. The camera lenses shall be covered by doors until required and such doors shall preferably be of the sliding type.

(viii) Sanitary funnels and rubber containers for the crew.

(ix) Dinghy.

25. Strength.

(a) When flying at 1.1 times the weight corresponding to the normal reconnaissance loading, the strength of the aeroplane shall not be less than the following standards:-

(i) the structure must have an ultimate factor of not less than 2 under any normal accelerations between 0 and 3.75G inclusive for the full range of speed up to 450 miles per hour A.S.I.

(ii) The normal requirements of A.P.970, except as modified by (i) above.

(b) When landing at 1.1 times the weight corresponding to the conditions stated in Paragraph 9 the requirements of A.P.970 shall be fulfilled, the vertical velocity of descent for energy absorption being 10 ft. per second.

(c) The tyres of the main undercarriage shall be suitable for operation at 40 lb. per sq. in. at the maximum overloaded condition. The tail wheel under this condition of loading may operate at 45 lb. per sq. in.

SPECIFICATION NO. 2/40/D.H.

I GENERAL.

1. This Specification and relevant Appendix B [not reproduced here] attached thereto detail particular requirements, relevant general requirements are given in Specification D.T.D. 1028 and it is essential that these requirements shall be completely fulfilled, as the particular requirements of this Specification, except where they are obviously inapplicable to an aeroplane of this type and where prior concurrence of the Director of Technical Development has been obtained. In particular paragraphs 12a, 15k and 24(i) of D.T.D. 1028 are not applicable.

2. Specification No. D.T.D. 1000 with the exception of paragraph 2, Interchangeability, shall be deemed to form part of this specification and shall be read in conjunction with it. The maintenance requirements for this specification are detailed in paragraph 27.

3. The marking of the aeroplane and aeroplane parts shall be in accordance with the requirements of Specification No. D.T.D. 1003 and any corrigenda thereto.

4. Prior to the delivery of the first aeroplane the contractor shall certify to the D.T.D., that it has been built in accordance with this specification, and that the requirements of A.P.970 (Edition May 1935), relevant Aircraft Design Memoranda and S.I.S.'s have been met, except where variations have been agreed to by the D.T.D.

5. (a) Drawing Procedure. The requirements of A.D.M.358 in relation to D.I.S. and drawing procedure shall be complied with except that where reference is made in A.D.M. 358 to master tracings, photographs of the master part will be acceptable provided the photograph is identified by a part and issue number.

(b) Duplicate Drawings. From the time when drawings are first issued to the shops, a duplicate set of all the drawings and schedules necessary for the manufacture of the aircraft shall be made and

maintained as a safeguard against destruction of the master drawings. These drawings are to be retained in the custody of the firm in accomodation agreed by D.T.D. to be suitable and maintained up-to-date. Where tracings on linen are made, the duplicate should be a velograph or other equivalent tracing. Where the drawings are unsuitable for this method of reproduction a blue print or other photoprint of similar permanence should be prepared.

6. Mock-up. The mock-up of the aircraft shall be available for the preliminary inspection within one month from the receipt of the order.

II OPERATIONAL REQUIREMENTS.

7. The main operational requirements are specified in the Appendix B [not reproduced here] to this Specification.

Crew Stations.

8. Parachutes. A seat type parachute shall be provided for the pilot and a lap type parachute for the navigator. A shield shall be provided at the parachute exit to protect crew when leaving the aircraft.

9. Noise level. The noise level at crew stations shall be such that intercommunication will work satisfactorily.

10. Pilot's Station. The pilot's seat is to be adjustable, in flight, through a 4" vertical range and the rudder bar adjustable in flight through a longitudinal range of 6". An arm rest is to be provided to reduce fatigue when manoeuvring with the throttle lever and comfortable foot-rests are required for use in straight flying when the feet are off the rudder bar.

A pocket is to be provided in which the pilot can stow miscellaneous articles such as gloves, stop-watch, goggles, data etc.

11. Flying Controls. The flying controls shall be located as nearly as possible in accordance with a standardised layout to the satisfaction of the D.T.D.

12. Windscreen. A draught-proof direct vision opening is required in the corner panel. Clear vision forward shall be provided by approved means. This may take the form of a glycol spray in conjunction with a windscreen wiper. "Tear drop" side panels are required for rearward view.

13. Heating. An efficient heating system, preferably employing waste heat from the engine, is essential at crew stations, and it is important that every precaution is taken to exclude draughts. In addition, the use of wool or plastics should be considered where control points come into contact with the hands and feet of the crew.

III DESIGN REQUIREMENTS.

Manufacture in Quantity.

14. Particular attention is to be paid in this design to the simplicity of construction and form of construction which will facilitate rapid manufacture.

Control Characteristics.

15. In the event of one engine failing during the take off, after unstick, it is desirable that full control of the aircraft shall be retained by use of the flying controls, without throttling back the retaining engine. In particular a control must be provided for very rapid adjustment of the rudder trim tabs to lessen the load on the rudder controls. This control is in addition to the fine adjustment normally provided.

Buoyancy.

16. The aircraft is to be capable of floating as nearly horizontal as possible to enable the crew to launch and embark in the dinghy. Inherent buoyancy of the structure shall provide a reserve buoyancy of 30% of the maximum all up weight at the reconnaissance load defined in paragraph 38(i).

Engine Installation.

17. Type. The aeroplane shall be fitted with RM.2SM ENGINES.

18. Starters. An approved form of electric starter shall be fitted with alternative hand starting gear.

Fuel System.

19. Capacity. The fuel tank capacity shall be sufficient to meet the requirements of Appendix B paragraph 6 [not reproduced here].

20. Protection. All tanks shall be rendered bullet-proof by an approved self-sealing process.

21. Refuelling. The fuel tanks shall be capable of receiving fuel at the rate of 30 gallons per minute through each of two pressure refuelling points. The system shall be designed to cater for a delivery pressure of 30 lb./sq. in. but the normal pressure will be 10 lb./sq. in. Gravity filling from cans shall also be possible.

22. Adequate tank venting and balancing pipe arrangements shall be made to ensure the tanks being filled simultaneously so far as is reasonable. This is in order that there shall be no possibility of one tank overflowing before the system is completely filled. Means shall be provided for draining away any excess fuel that may be spilled around the refuelling point. Precautions shall be taken to ensure that the petrol fumes do not reach the cabin.

23. Mock-up. At the earliest possible stage in the design of the aircraft, a working mock-up of the proposed fuel system shall be prepared by the contractor. This mock-up shall include all pipes fittings etc., in the same shapes, lengths and positions as proposed in the actual aircraft. It shall be capable of being tested with a motor driven pump and there shall be adequate provision for making observations of the flow of fuel. The mock-up should be capable of simulating such change in attitude of the aircraft as are likely to occur in flight. Provision should also be made to simulate the effects of the fuel system of changes in pressure due to flow over such items as tank vents and air intakes. The mock-up shall be maintained throughout the design and construction of the aircraft, and until such time as it is agreed by the Air Ministry to have served its purpose. Such alterations to the original fuel system layout as are found necessary in the course of design and construction of the aircraft, shall be incorporated and tested in the mock-up. A fuel system mock-up conference will be convened by the Air Ministry to examine and test the mock-up, and the recommendations of this conference shall be subjected to the same conditions as those of the aeroplane mock-up conference (see D.T.D. Specification No.1028, paragraph 4 and 11).

Oil System.

24. The nett capacity of the oil system shall not be less than B gallons where

$$B = C (E + 2)$$

where:-

E = endurance in hours at the maximum power available for economical cruising, the endurance being based on the maximum fuel tankage.

C = the maximum rate of oil consumption in gallons per hour approved by D.T.D. (R.D.E.) when the engine is operating at the maximum r.p.m. for economical cruising.

25. All oil tanks shall be rendered bullet-proof by an approved self-sealing process.

Bomb-Installation.

26. Specification D.T.D. 1007 shall be used as a guide to the design of the bomb installations. Special consideration is to be given to the accessibility of the bomb gear to facilitate changes in the equipment for the various bomb loads. The time required for loading the bombs should be as short as possible and all the necessary winch gears and equipment for loading should be included in the design and capable of being carried in the aeroplane as alternative load. Standard bomb loading and winch gear should be incorporated as far as possible.

Maintenance.

27. The maintenance and interchangeability requirements of specifications D.T.D. 1000 and 1028 shall be complied with as far as possible. For this aircraft however it is recognised that concessions on these requirements will be necessary to obtain the required performance, and in particular relaxation of A.D.M. 340 requirements will be allowed.

The essential requirements on which concessions cannot be granted are as follows:-

(i) The attachment points of all main components including cowlings shall be strictly interchangeable so that spare parts may be fitted without adjustment. This requirement shall be met as early as possible in production and not later than the seventh aircraft.

(ii) The time required for changing engines shall be as short as possible to the satisfaction of the D.T.D.

(iii) Easy access top controls and pipe-lines for inspection.

(iv) Lubricators to all working parts are required with easy access to them.

(v) It shall be possible to remove filters from fuel and oil tanks without the necessity of draining the tanks.

(vi) It shall be possible to drain fuel, oil and coolant tanks without the use of pumps, syphons or other like equipment.

(vii) Jacking pads shall be incorporated in the design to enable the undercarriage and other parts to be removed. It shall also be possible to test under-carriage retraction as a routine operation, when the aircraft is jacked-up. Points for jacking and trestling are to be clearly marked.

(viii) The documentary dues called for in Specification D.T.D. 1000 paragraph 9(d) shall be supplied. With reference to paragraph 1(c) of Contracts Letter No. 23, as amended by Contracts letter No. 123, the first aeroplane referred to shall be taken as the sixth aircraft built to this Specification. The documentary dues normally required for prototype aircraft and called for in the contracts letter No. 22 will not be required. The Contractor will however be required to co-operate with the D.T.D. in the preparation of the pilot's handling notes during the contractors flight trials of the aeroplane.

Aircraft Picketed Down.

28. Provision is to be made to enable the aircraft to be safely tethered in the open for storage purposes. For this purpose strong points are to be provided to which anchorage can be attached at positions to be agreed by the D.T.D. Such anchorages shall enable the aircraft to withstand safely gusts up to 90 m.p.h. in any direction relative to the aircraft. For the purpose of this requirement it shall be assumed that the control surfaces are locked by external means. The contractor is not required to make any special arrangements for such gear. The detailed requirements for picketing are specified in A.D.M.422 which will be promulgated shortly.

Miscellaneous Requirements.

29. Finish. The aircraft is to be camouflaged to Air Diagram No. 1159 using the 'S' type finish.

30. Protective Treatment. Class A protective treatment will be required for metal components in accordance with A.D.M.'s 325. The wooden structure

shall be protected in accordance with A.D.M. 325.

31. Aerials. All aerials shall be accommodated inside the structure with the expectation of the exception of the trailing aerial.

32. Fire Extinguishers. A Graviner or other approved type of fire extinguishers shall be fitted in each engine bay, for automatic action by heat, inversion or by shock and for manual operation under the control of the pilot. Two small methyl bromide extinguishers shall be fitted inside the fuselage.

33. Anti-icing precautions. The airscrews shall be provided with an approved form of de-icing equipment. De-icing fluid shall be provided for three hours on the basis of a consumption of 2 pints per blade per hour. The wings, tail unit and fin are to be suitable for the paste method of de-icing.

34. Flying Instruments. A Standard flying instrument panel shall be fitted with operation by an engine driven vacuum pump. Alternative operation shall be obtained by the use of two engine driven pumps with change over cock and a vacuum gauge.

35. Screening. In addition to the requirements of G.E.125 compliance with Specification E. & I. 442 is required.

36. Equipment for flight trials. The aircraft allotted for flight trials shall be equipped as follows:-

(i) The first aircraft. Full provision for taking equipment is not required but the aircraft shall be such that provision for the installation of all equipment can be added later if required. This aeroplane will be used for handling trials.

(ii) The first two aircraft allotted to the A. & A.E.E. shall be equipped to the full Appendix A [not reproduced here] standard.

(iii) The two aircraft allotted to the Service shall be equipped to the normal D. of E. Standard.

37. For the purpose of performance and endurance trials two aircraft allotted to the A. & A.E.E. shall be equipped with:-

(a) Flowmeters or other approved arrangements to measure the fuel consumption for the whole aircraft in accordance with paragraph 19(a) of Specification D.T.D. 1004.

(b) Distant reading thermometers to measure oil inlet and outlet temperatures in accordance with paragraph 13(a) of Specification D.T.D. 1008.

(c) Electric cables (Ref. 5E/1423) for Kollsman engine speed indicators.

(d) Provision for fitting Mark II boost gauges.

(e) Distant reading radiator thermometer to measure the temperature of the coolant leaving the radiator.

Full ground equipment shall be supplied with the first fully equipped aircraft delivered to the A. & A.E.E.

Typical Service Load.

38. The typical service load for the purpose of strength calculations and flight trials shall comprise:-

(i) Reconnaissance Case.

(a) The military load specified at "A" hereunder together with the tare weight items shown in Column 10 of the Appendix A [not reproduced here] No. 1066 and such removable non-standard parts as it will be necessary for the contractor to supply and fit in order that this military load may be carried.

(b) The fuel, oil and cooling liquid for the range specified in paragraph 6(i) of the Appendix B [not reproduced here] plus the necessary allowances.

(ii) Bomber Case.

(a) The military load specified at 'B' hereunder together with the tare weight items shown in column 10 of the Appendix A [not reproduced here] No.1066 and such removable non-standard parts as it will be necessary for the contractor to supply and fit in order that this military load may be carried.

(b) The fuel, oil and cooling liquid for the range specified in paragraph 6(ii) of the Appendix B [not reproduced here] plus the necessary allowances.

Military Load.

(Crew and Removable Standard Items only).

	"A" Load (lbs.)	"B" Load (lbs.)
Crew, two, including parachutes	400.0	400.00
Bombs, bomb sight, carriers and distributors	_	1120.0
Marine Distress Signals	10.5	10.5
Signal pistol and 20 cartridges	8.5	8.5

Flying instruments	.5	.5
Navigational	22.5	22.5
Cameras, F.24, two and one 9” x 9”	(182.0)	_
Cameras, F.24, two	_	71.5
Oxygen	87.5	87.5
Dinghy	25.0	25.0
Rations	6.0	6.0
Vacuum flasks	8.0	8.0
First Aid	3.0	3.0
Direction finding T.1154 – R.3003	(110.0)	(110.0)
R.3003	28.0	28.0
Intercommunication	22.0	22.0
Totals	913.5	1923.0

IV STRUCTURAL STRENGTH.

39. The strength of the aeroplane shall not be less than is defined hereunder.

In Flight.

40. When carrying the load specified in paragraph 38(i) the strength shall not be less than the following standards:-

(a) The structure must have an ultimate factor not between 0 and +3.5g. inclusive, for the full range of speed up to 450 m.p.h. I.A.S. This case replaces the normal C.P.F., C.P.B. and dive cases.

(b) The structure must have an ultimate factor not less than 2 under any normal acceleration between 0 and –1g inclusive for the full range of speed up to the maximum level speed. This case replaces the normal inverted flight case.

(c) The requirements of A.P.970 and all current A.D.M.’s applicable to T.V. class of aeroplanes except where modified by paragraphs (a) and (b) above, and except where otherwise agreed with Airworthiness Department. The load factors quoted for “other than experimental aeroplanes” in A.P.970 shall be assumed.

The Contractor should refer to the Airworthiness Department R.A.E., in case of doubt in the application or interpretation of rationalised flight cases quoted.

Landing and Take-off.

41. The requirements of A.P.970 shall be satisfied when carrying the reconnaissance load, specified in paragraph 38(i) and the vertical velocity of descent for energy absorption (A.P.970 Ch.III para.2) shall be 10 ft/sec. At this velocity the impact load on the undercarriage shall not exceed 3.0 times the weight of the aircraft at the reconnaissance load. A representative shock absorber unit from the main under carriage and one from the tail wheel, each complete with wheel and tyre are to be tested for shock absorption properties unless the type has been previously tested to the satisfaction of the D.T.D. The tests will be the subject of an extra to Contract or, if made at the R.A.E. will be done at Air Ministry expense. The components are not expected to be rendered unserviceable in the tests and if serviceable will be available for incorporation in the aircraft.

The type pressure at the maximum all up weight, paragraph 38(i) shall not exceed 40 lbs. per sq. inch. The tail wheel pressure at this load may not exceed 45 lb./sq.inch.

42. (a) If it can be shown that the shock absorption characteristics of the undercarriage are such that the tyre would not be fully compressed in a landing at the specified vertical velocity, then the operational load for the type may be based on a static deflection of up to 40% at 35 lb./sq. inch at the reconnaissance weight.

(b) In conjunction with the requirements at (a) the vertical reactions quoted in A.P.970 for strength calculations may be reduced in the ratio of

$$\frac{\text{Maximum acceleration resulting from a landing at the specified velocity.}}{3.0}$$

Subject to a minimum ratio of 2.5/3.0. The factor for the undercarriage on these cases shall be the same as those at present specified for the airframe (A.P.970 Ch.III para.4).

V CONTRACTOR'S FLIGHT TRIALS.

43. Prior to the delivery of the first aircraft the Contractor will be required to carry out such portions of the general flying tests in accordance with Aircraft Design Memorandum No. 291. with the exception of spinning and Aerobatic tests called for in paragraphs 8 and 9, as are considered desirable

by the D.T.D. The Contractor will be required to certify that the tests done have shown the aeroplane is safe to be flown by an R.A.F. pilot.

44. Prior to the delivery of the second aircraft it shall have been certified to the D.T.D. by the Contractor that –

(i) The aeroplane has been subjected by the Contractor's pilot to the general flying tests in accordance with Aircraft Design Memorandum No.291, with the exception of the spinning and aerobatic tests called for in paras. 8 and 9 at both the reconnaissance and bomber weights except that the bomber case will be treated as an overload condition as defined in paragraph 13 of A.D.M.291 and the aircraft will not be required to land or dive at that weight.

(ii) The above mentioned tests have shown that the aeroplane is safe to be flown by an R.A.F. pilot.

45. Wind Tunnel Tests.

In order that the design may be considered as regards spinning and if necessary a model or models of the complete aeroplane may be constructed for tests of its spinning characteristics, the Contractor is to supply the Chief Superintendent, Royal Aircraft Establishment, B.A. Department, drawings in duplicate:-

(i) Its general arrangement in front elevation, side elevation and plan.

(ii) Its wing section.

(iii) The distribution of its mass relevant to each of the three principal axes.

(iv) The position of its centre of gravity.

The drawings shall be forwarded immediately to enable the model to be made and tested at the Royal Aircraft Establishment before the construction of the aeroplane is so far advanced that alteration to the fuselage and tail unit would be difficult. The contractor shall forward with the above-mentioned drawings a complete aerodynamic data sheet, a proforma of which will be supplied to him by the D.T.D. (R.D.T.1) at or about the time when the contract is placed.

Centre of Gravity.

46. Reference D.T.D.1028, para.28(b)(iii) the calculated coordinate normal to the datum line may be accepted provided the error in the

calculated value of the co-ordinate parallel with the datum line when compared with the measured value is not greater than 2% of the mean chord.

Before delivery of the first aircraft the contractor shall supply to the D.T.D. particulars of C.G. data which will enable the centre of gravity to be determined for any variations of Service Load.

VI FINAL EXAMINATION.

47. The contractor shall provide facilities at his works for a final examination of the second aircraft in its completed or nearly completed state to be made on behalf of the Director of Technical Development in order to check that the aircraft and its installations are satisfactory. This examination shall take place as soon as possible after the aircraft has passed the inspection required by the Director of Aeronautical Inspection for the purpose of the final examination.

48. The aircraft is to be presented for examination equipped in accordance with the relevant Appendix “A” [not reproduced here]. If so required, the Contractor shall subsequently take out the removable equipment forming part of the military load and shall install the alternative items of removable equipment that are detailed in Appendix “A” [not reproduced here] or he shall demonstrate that the alternative items can be installed in a satisfactory manner.

49. Items of non-standard ancillary equipment which the contractor has to supply with the aircraft are to be available for examination at the final examination of the aircraft and if so required, the contractor shall demonstrate their use.

1st Part of Report No.A.A.E.E.767 (Part I)
3rd March, 1941.

AEROPLANE AND ARMAMENT EXPERIMENTAL ESTABLISHMENT.

BOSCOMBE DOWN.

MOSQUITO W.4050

(2 MERLIN XXI ENGINES)

Preliminary Performance and Brief Handling Trials.

Part I.

A. & A.E.E. Ref:- 4487/44 - A.M.61.
M.A.P. Ref:-

GENERAL SUMMARY.

1. Introduction.

Brief performance and handling tests were required. The tests were interrupted by a failure to the fuselage which necessitated the reconstruction of the aeroplane. The results obtained are based on only 6½ hours flying and are therefore in some respects not complete.

2. Description of Aeroplane.

The Mosquito is a twin-engined aeroplane of wooden construction. The main members of the wings and fuselage are of wood and the covering is of plywood stiffened with balsa wood. The elevators and rudder are of metal structure with fabric covering and the ailerons are of metal covering. Photographs of the aeroplane are shown at the end of the Report.

The aeroplane had no armament or other operational equipment and was only lightly loaded. The weight was 16,770 lb. and the C.C. was 13.6 inch aft of the datum (0.306 A.M.C. undercarriage down and 0.323 A.M.C. undercarrings up).

Buffeting had been experienced by the Firm's pilot at normal speeds and extensions to the nacelles had been found to get rid of the trouble. The aeroplane as flown by the A. & A.E.E. pilots had the original nacelles fitted.

3. Tests made.

The following tests were made:-

(a) Brief handling tests, including ground handling, take offs and landings with different flap settings, a few tests at the stall with flaps up and down, longitudinal stability tests and gentle dives. Observation was also made of buffeting which has been reported by the Firm's pilot.

(b) A performance climb to 30,000 feet with radiator flap closed.

(c) Measurements of level speeds at heights from 16,000 feet to 24,000 feet.

(d) Cooling climbs with radiator flap open and closed.

(e) Measurement of position error over the range 857 to 298 m.p.h. A.S.I.

(f) No special maintenance tests were done, but points raised during daily inspections have been commented on.

4. Results of Tests.

(a) The aeroplane is pleasant to fly. The aileron control is light and effective, the elevators are rather heavy but effective and rudder is heavy. Take-offs and landings are quite straightforward.

The behaviour at the stall is not vicious, either with flaps up or down. Warning of the stall, which occurs at 105 m.p.h. A.S.I. with flaps up, and 90 m.p.h. A.S.I. with flaps down, is given by buffeting.

Buffeting in normal flight, which has no direct connection with the buffeting near the stall, was observed at speeds of 170 m.p.h. A.S.I. and higher speeds, but was not considered serious at the speeds at which the Mosquito was flown, up to 320 m.p.h. A.S.I. If attention had not been drawn to the buffeting by the Firm's pilot, it is likely that adverse criticism would not have been made.

No tests were made with the nacelle extensions fitted.

Longitudinal instability was found to be present on the climb, in level flight and on the glide. The instability is not serious with the

present C.G. position (0.32 A.M.C.) but it would be a handicap if the Mosquito is flown at night or for long distance work.

(b) The performance climb was made with the radiator flap in the closed position. The climb had to be interrupted by a section of climb at a higher speed than the best climbing speed because of inadequate cooling. It was continued to 30,000 feet and the Service ceiling is roughly determined as 34,000 feet.

The best rate of climb in M.S. blower is 2880 feet/min. At 11,400 feet in F.S. blower is 2240 feet/minute at 18,100 feet.

(c) The top speed in F.S. blower is 388 m.p.h. at 22,000 feet.

(d) With radiator flap closed the radiator suitability is well below the requirements for English Summer conditions. The oil cooling is nearly up to these requirements. With radiator flap open the climb was not continued beyond 15,000 feet, but there is enough information to suggest that the radiator suitability will be adequate for English summer conditions and the oil cooling nearly adequate for tropical summer conditions.

(e) The position error was measured over the range 157 to 298 m.p.h. A.S.I. by the aneroid method. The P.E.C. is large, varying from about +12 m.p.h. at the former speed to +29 m.p.h. at the latter.

Further Developments.

In order to make certain whether the buffeting of the Mosquito with the original nacelles is sufficiently serious to call for a modification, tests ought to be made at the full weight and at the maximum permissible diving speed.

The longitudinal instability ought to be determined with the C.G. in the furthest aft position (0.35 A.M.C.)

SECRET **A.F.C. 126**

AIR FIGHTING DEVELOPMENT UNIT.
R.A.F. STATION, DUXFORD.
REPORT NO.39
on
TACTICAL TRIALS – MOSQUITO BOMBER

INTRODUCTION

1. In accordance with Air Ministry instructions a Mosquito Bomber, W.4062, was delivered to this Unit on 12.11.41, for tactical trials.

BRIEF DESCRIPTION OF THE AIRCRAFT

General

2. The Mosquito is a mid-wing monoplane of wooden monocoque construction, powered with two Merlin 21 engines of 1150 h.p. each. The bomber version carries no armament.

3. The present maximum all-up weight of the aircraft is 19,400 lbs. This constitutes a full load of petrol and 1500 lbs. of bombs, and gives a total operational range of approximately 1,400 miles. With long range tanks fitted in the bomb bay it is capable of about 1,800 miles.

Crew

4. The crew of two consists of a pilot and an observer, who also acts as bomb-aimer, W/T Operator and Navigator.

Cockpit

5. The pilot's cockpit is well laid out though a trifle cramped and this together with the pilot's upright position may cause fatigue on a long flight. The various controls and instruments are well placed and easily accessible. The pilot sits on the left side and the observer normally sits beside the pilot

where he carries out his duties as navigator, W/T operator and lock-out. The bomb sight is situated in the nose forward of the pilot and it is necessary for the observer to move into this position before bombing. A clear view panel is provided for bomb aiming. The heating of the cockpit is exceptionally good, and even in winter at altitude no bulky flying clothing need be worn. In summer the cockpit may prove to be rather too warm.

View

6. The crew have a good view above the horizontal to the sides, front and above and can see moderately well to the rear. Their view downwards and backwards, however, into the area they must search carefully is particularly bad, partly due to the blind spot and partly to the fact that both members of the crew are facing forwards and so it is difficult for them to search thoroughly then they can only look over their shoulders. On some occasions the observer knelt on his seat facing backwards and this made a certain improvement. It was found during the trials that a fighter could often approach from the rear and below without the crew being aware of its attack. Blisters are fitted to the sides of the cockpit but are difficult to use in full flying kit. Experiments were carried out with mirrors in the blisters and these were found to be a definite advantage for keeping a look-out to the rear and slightly below.

Armour

7. The pilot is protected from behind by armour plate of 7 mm. thickness, extending from the level of his seat to the top of his head. The observer is similarly protected from behind by armour plate of 9 mm. thickness, and there is a circular section of bullet proof glass behind his head so that his rearward view is not hindered. The upper part of the armour plate is hinged to enable the observer to operate the wireless which is behind it. There is no armour protection for the engines.

Fuel and Oil Tanks

8. Fuel is carried in 10 self-sealing tanks as follows:-

4 Outboard wing of	118 galls.
4 Inboard wing of	289 galls.
2 Centre fuselage of	136 galls.

2 Fuselage long range tanks (if fitted)	155 galls.
TOTAL CAPACITY OF	698 galls.

Oil is carried in 2 self-scaling tanks, one in each engine nacelle and a third can be carried in the fuselage if the long range tanks are fitted.

Bomb Load

9. The maximum bomb load at present is 1,500 lbs., and is made up of two 500 lbs. and two 250 lbs. It is understood, however, that it may be possible to increase the load to a maximum of 2,500 lbs., when bombs with collapsible tail units are available.

Radio

10. The aircraft is fitted with the standard Marconi installation for bombers which is satisfactory and the intercommunication between pilot and observer is very good.

FLYING CHARACTERISTICS

11. The Mosquito is very manoeuvrable both light and fully loaded. The controls are light and positive at all speeds, the rudder being rather heavier than elevators or ailerons.

Performance

12. The Mosquito is capable of a high top speed. Comparative trials were carried out with a Spitfire VB in which both aircraft carried full operational loads and were fitted with snowguards. The Mosquito carried a full load of petrol and 1,000 lbs. of bombs throughout the majority of the trials, though very little difference was noticed when the bombs were removed. At 21,000 feet without using emergency boost the Mosquito appeared 4 – 5 m.p.h. faster than the Spitfire which was using its emergency boost in an attempt to keep up. This gives the Mosquito a true top speed of about 375 m.p.h. At 600 feet both aircraft attained approximately the same speed but the Spitfire was again using emergency boost while the Mosquito was not. Above

24,000 feet the performance of the Mosquito appears to fall off in comparison with the Spitfire.

13. The Mosquito climbs quickly, especially when light. At its maximum rate of climb it can reach 20,000 feet in just over 9 minutes from the start of the take-off run, which is only about 2 ½ minutes longer than taken by a Spitfire. The addition of bomb load does not seriously detract from its performance. The operational ceiling appears to be around 30,000 feet.

14. When diving the Mosquito accelerates well and in a slight dive at altitude quickly reaches the limiting speed of 360 m.p.h. Indicated Airspeed.

15. Single engine flying was carried out with each engine feathered in turn and it was found that the Mosquito can maintain height and climb comfortably on one engine, there being enough rudder trim available to enable the aircraft to be flown hands off. Again the bomb load of 1,000 lbs. appears to make very little difference to the single engined handling. Turns with and against the live engine were carried out with case.

Instrument Flying

16. The blind flying panel is well placed and instrument flying is confortable. At cruising speeds the aircraft is very stable and can be trimmed easily to fly hands off.

Night Flying

17. No difficulty was experienced in night flying, the lighting being good for all essential instruments and cockpit controls without causing reflections on to the cockpit hood. The exhaust flames, however, which cannot be seen from the cockpit, are rather bright when viewed from behind.

Formation Flying

18. No second Mosquito was available for testing the qualities of the aircraft in formation, but it is thought that this will present no difficulty. Since formation flying is normally only resorted to by aircraft having defensive armament in order to give mutual fire support, there is unlikely to be any need for unarmed aircraft to fly operationally in formation. This would simply present a larger target to flak and fighters and hamper evasive action.

FIGHTING MANOEUVRES

General

19. Interceptions and attacks were attempted by Spitfire V aircraft at various altitudes. If the fighter was allowed to close range, the Mosquito was unable to throw it off as its lower safety factor of 6 does not allow sufficiently violent manoeuvring with safety. Owing to the high speed and light elevator control of the Mosquito, high acceleration forces are easily imposed but will normally be avoided as the upright position of the crew reduces the amount of 'G' that can be withstood without "blacking out".

20. If the Mosquito is cruising fast, the only present day fighters which are likely to be dangerous will have to dive down from a greater height than the Mosquito in order to attain enough speed to carry out an attack. Those that are climbing up from below will never come in range and any on the same level as the Mosquito, if seen in time, can be kept out of range if the Mosquito accelerates quickly.

Search

21. The Mosquito having no armament, the only tactics open to it are evasion either by speed or manoeuvrability. The key to the effectiveness of either lies in seeing the fighter in time and the view of the crew, though good forward and above the horizontal, is very blind backwards and downwards. A sharp lookout is essential at all times, especially in a danger area, and wide weaving is necessary to keep the blind spots in view as much as possible, otherwise a fighter can dive down and overtake slightly below to carry out an attack without being seen at all. It was found very difficult even with quite wide weaving to pick up a single fighter which was more than 1,000 feet below. During the trials a few successful fighter attacks were not observed at all, although the crew were expecting the attacks, due partly to the blind spot, and partly to the difficulty of searching throughly in any direction other than that in which they were facing. In particular when approaching the target area, when the observer is over the bomb sights, the pilot must try to cover the whole area of search behind and below by himself. This difficult task was eased considerably by adjusting the mirror fitted in the starboard blister (para.6) to help in covering the starboard quarter.

High Altitude

22. The best performance of the Mosquito being obtained at 21,000 feet, the majority of altitude interceptions and attacks were carried out at or just above this height.

23. The Mosquito being superior in speed to the Spitfire at all heights below about 24,000 feet, its best evasion was by accelerating away and preventing the fighter coming into range. If the Spitfire attacked with a 3,000 feet advantage the Mosquito was never able to accelerate enough from fast cruising to prevent the Spitfire from diving down below and getting in a burst of fire of fairly long duration from astern. But if the Spitfire was only about 2,000 feet above and 1,000 yards away on the beam, the Mosquito could get away. In each case the Mosquito's acceleration was helped by its going into a slight dive. It appears therefore that the best operating height is one that is above 21,000 feet, to allow the Mosquito to accelerate in a dive down to its rated altitude.

24. During these trials the Mosquito had to weave and turn as soon as the Spitfire dived down behind and below in order to keep it in view and it attempted evasion by means of turning when the fighter came into range. This was not particularly effective as the Mosquito could not go into a turn at high speed which was violent enough to throw the fighter off or upset his aim unduly at short range.

25. As an alternative when the Spitfire was coming into range the Mosquito attempted a corkscrewing movement, diving about 500 feet in a turn end recovering by a climb and turn in the opposite direction. During the first attempts the engines cut badly at the top of this manoeuvre when the aircraft was put into a dive and the movement was hardly violent enough to be effective. R.A.E. type restrictors as fitted to Merlin XX and 45 engines in Fighter Command were placed in the fuel supply pipe lines and gave a great improvement, preventing the cutting of the engines under "negative G" and making the manoeuvre quite effective. At high speed pilots found it uncomfortable to make sudden movements in the fore and aft plane and at heights above about 20,000 feet it felt as if this evasion was so slight that it was not putting the fighter off his aim. In actual fact it has been found that very slight movements by a target travelling at high speed forces a fighter pilot to allow considerable deflection and this form of evasion, even at altitude, usually prevented the fighter from taking an accurate aim.

Since the fighter on occasion was able to remain in range dead astern for a considerable period, this evasion was found necessary and more effective for upsetting his aim at long range than an attempt to turn. It had the added advantage of allowing the Mosquito to remain more or less on its original course.

Medium Altitude

26. The Mosquito's performance at lower altitudes still being superior to the Spitfire, similar results were obtained at the rated altitude for the 'M' Supercharger, i.e. about 15,000 feet, but the corkscrewing movement was easier to carry out at this height. If the Mosquito therefore is unable to operate as high as 21,000 feet it should try to fly slightly above 15,000 feet in order to benefit from the acceleration picked up in a dive down to the lower rated altitude.

Low Altitude

27. Trials were also carried out below 1,000 feet in a similar way to those at altitude with rather similar results. The Mosquito had a far better chance of spotting fighters as they were usually attacking from above and if seen in time it could always accelerate away.

28. The forward view from the Mosquito being extremely good, low flying can be carried out quite easily and with practice fairly steep turns and evasions carried out at high speed. Such turns provided more effective evasion than at altitude but even so the fighter if in close range was presented with a fairly easy shot. The corkscrewing manoeuvre, however, could be carried out far more easily than at altitude and was the more effective, especially as the fighter was frequently forced into the slipstream which he found particularly uncomfortable near the ground.

Effects of opening the bomb doors

29. The reduction in speed caused by the opening of the bomb doors and the time to open and close were noted, and attacks carried out on the Mosquito with bomb doors open. It was found that at a fast cruising speed the Mosquito lost about 20 m.p.h. over a period of 3 minutes by opening the bomb doors. The doors opened in 13 seconds and closed in 11 seconds and

the time taken to accelerate back to the original speed was approximately 30 seconds from the commencement of closing.

30. During the attacks which were subsequently carried out at 24,000 feet, it was found that the Mosquito could just keep out of range of a fighter seen for instance 2,000 feet above and 1,200 yards away if the bomb doors were closed immediately and the Mosquito accelerated in a slight dive. During attacks carried out at 1,000 feet, however, the doors had to be closed while the fighter was much further away, as it was impossible for the Mosquito to dive far to gain speed.

Evasion by climbing

31. The rate of climb of the Mosquito being so good, a few attacks were carried out while it flew between 1,000 and 2,000 feet below cloud. Unless the fighter was allowed to get nearer than 1,000 yards, the Mosquito had no trouble in gaining cloud cover.

Slipstream

32. The slipstream behind the Mosquito only covers a very small area and is encountered on the level, being most noticeable slightly to port. Though strong from 400 yards inwards, it did not disturb the fighters except when the Mosquito was at very low altitude and corkscrewing, when they flew into it frequently and found difficulty in sighting. At 600 yards and over its effects were negligible.

CONCLUSIONS

General

33. The Mosquito is very manoeuvrable both light and fully loaded. (para.11).

34. The Mosquito is faster than the Spitfire V at all altitudes up to about 24,000 feet. Its rate of climb is very little less than that of a Spitfire up to 20,000 feet and it accelerates well in a dive. (paras. 12–14).

35. The crew’s view is good, save backwards and downwards, where it is bad. Fighters can approach from the rear without the crew being aware of their attacks. Mirrors in the blisters help the crew to make a more complete search. (para.6).

36. Armour protection for the crew is good from the rear but there is none for the engines. (para. 7).

Tactics

37. The only present day fighters which are likely to be dangerous are these which dive down from a greater height and therefore a very keen lookout must be kept for such attacks. (paras. 20–21).

38. The Mosquito should be operated a few thousand feet above its rated altitude in order to allow it to accelerate away from fighters as it dives down to the height at which it can obtain its best performance. (para. 23).

39. If a fighter manages to get into range without being observed, the Mosquito should attempt to accelerate away with a diving turn or corkscrewing movement which upsets the fighter's aim, especially at long range and high speed. (paras. 24 & 25).

40. The corkscrew manoeuvre feels difficult to carry out at altitude and at high speeds but becomes easier as height is reduced. Even so, it upsets the fighter's aim considerably, especially at long range. (paras. 25 & 26).

41. The slipstream from the Mosquito did not disturb fighters escort when attacking at very low altitude, when it upset their sighting. (para. 32).

42. The bomb doors are rather slow in operating and reduced the Mosquito's speed by about 20 m.p.h. from fast cruising. At 20,000 feet it could just keep out of range of fighter attacks if the doors were closed immediately and the Mosquito accelerated in a slight dive, but when flying near the ground it was very vulnerable with the doors open. (paras. 29 & 30).

AFDU/3/19/57
27.3.42

[signed]
Ian Campbell-Orde
Wing Commander, Commanding A.F.D.U.

CHAPTER II
Pilot Notes

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INTRODUCTION

1. The Mosquito is an all-wood mid-wing monoplane with two Merlin XXI engines and Hydromatic three-blade airscrews. It is designed and equipped for the duties of a high-speed bomber and reconnaissance aeroplane and carries a crew of two – pilot and air observer (who also acts as bomb aimer, photographer, wireless operator and navigator). No armament is carried.

2. The overall wing span is 54 ft. 2 in. the overall length 40 ft. 9.5 in. and the height over airscrew tip, blade vertically upwards, tail wheel on the ground, 15 ft. 3 in.

3. Forward of the instrument board in the nose of the fuselage, is the bomb aimer's position, the bomb sight being mounted on a bracket on the left-hand side of the nose behind the observation panel.

4. The pilot's seat is on the left and the air observer's seat on the right-hand side just aft of the pilot's seat. The backs of both seats are made of armour plate and in the case of the air observer, is hinged, to facilitate the use of the wireless instruments, etc., situated at the back of the seats. A chart table is folded against the fuselage side with a map stowage case behind. The table opens out in front of the air observer's seat and is supported by a stay tube fixed to the centre of the seat.

5. The fuselage is of oval, tapering cross section, made up in halves, and joined along the top and bottom centres. The construction is of balsa wood sandwiched between plywood sheeting, which forms a monocoque with occasional wood bulkheads.

6. The wing is a wooden cantilever structure consisting of two box spars, extending over the full span, with a stressed plywood skin covering reinforced by

spanwise wooden stringers. Provision is made to house ten fuel tanks within the wing; the tank bays are provided with detachable panels on the underside which, when in position, form part of the stressed skin. The wing is attached to the fuselage by four main bolts. Slotted flaps and ailerons are fitted.

7. The tail plane is a wooden cantilever structure consisting of two box spars extending over the full span, wooden ribs and stressed plywood skin. The elevators and rudder are Alclad structures, with fabric covering. The fin is of similar construction to the tail plane. The aileron construction is of Alclad ribs covered with Alclad sheet.

8. The alighting gear consists of two single wheel retractable undercarriage units, one under each engine nacelle, and a retractable tail wheel unit. The undercarriage and tail wheel units are each provided with a single hydraulic jack for retracting and lowering.

The opening through which the undercarriage retracts into the engine nacelle is entirely closed by mechanically operated doors which complete the streamline shape of the nacelle. A small portion of the tail wheel remains exposed in the retracted position. The undercarriage is mechanically locked in the up and down position. The brakes are pneumatically operated.

9. The flying controls are conventional in operation. A handwheel is mounted on a vertical control column for aileron and elevator control and the rudder is operated by pendulum type pedals which are adjustable fore and aft. Operation is by means of cables, tie rods and chains.

10. The rudder, elevator and ailerons are provided with combined trimming and balance tabs. On the left-hand side of the pilot is the elevator tab control wheel. The aileron tab is operated by a small hand wheel at the bottom right-hand side of the instrument panel. The rudder trimming tab is operated from a control box situated above the instrument panel in the cockpit roof.

11. Two Merlin XXI engines are mounted on steel tube structures built out from the front main spar and drive three-blade Hydromatic airscrews. The oil and coolant radiators for each engine are built into the main plane leading edge between the engine nacelles and the fuselage. The coolant temperature is regulated by an electro-pneumatic ram controlled flap in the radiator duct exit. Engine controls are operated through torque tubes and bell-cranks.

12. A hydraulic pump is fitted to each engine for the operation of the alighting gear, wing flaps and bomb door jacks. A vacuum pump is fitted to each engine for the operation of the B.F. Instruments. The port engine drives a Heywood compressor for brake and coolant radiator flap operation.

13. Fuel may be supplied to the engines from either (i) the outboard tanks or (ii) from the interconnected inboard and centre tanks. The outboard tanks are normally selected for take-off owing to the more direct pipeline run to the engines.

14. A 24 volt 1000 watt generator is fitted to the left-hand side of the starboard engine. Two 12 volt 40 amp/hr. accumulators are mounted in series aft of the rear spar on the floor of the rear compartment and supply all the electrical services, i.e., landing lamps, navigation lights, Graviner fire extinguishers, wireless equipment, motor generator, bomb release and fusing, camera motors, etc.

15. The wireless equipment is mounted aft of the air observer and the pilot's seats on top of the centre portion of the main plane and comprises a transmitter T.1154.B, a receiver R.1155 behind the pilot's seat, and a control unit for R.3003 which are operated in conjunction with the intercommunication unit A.1134 mounted beneath the receiver R.1155. A.D.F. loop aerial is positioned in the roof in front of the transmitter T.1154. The aerial for the receiver R.3003 is mounted on the front face of the front spar of the tail plane. The receiver R.1155 has a fixed external aerial. Provision is made for a trailing aerial next to the air observer's seat.

16. Various alternative bomb loads are carried in the main cell underneath the fuselage, i.e., 2 – 500 lbs. S.A.P., or G.P., or 4 – 250 lbs. S.A.P., or G.P., or two small bomb containers. The bomb doors are operated by hydraulic jacks, which are controlled by a lever in the pilot's cockpit.

17. Arrangement is made for F.24 or two series IX cameras to be carried with or without bombs.

18. Without bombs, two F.24 or two series IX cameras may be mounted forward in the bomb compartment for verticals or obliques and one F.24 or two Series IX in the rear fuselage for verticals only.

19. With two 500lb. bombs only, two F.24 cameras may be mounted vertically in the forward position, and forward obliques can be obtained by a hand held camera through the bomb aimer's observation panel.

20. For normal reconnaissance, two F.24 cameras are mounted in the forward position, for verticals or obliques, and one F24 or series IX camera aft for verticals only. Provision is made for heating all cameras.

21. Cabin heating and cold air ventilation is controllable, a section of the coolant radiator forming the source of heat supply.

CONTROLS AND EQUIPMENT FOR PILOT AND GENERAL EMERGENCY EQUIPMENT AND EXITS

INTRODUCTORY

1. This section explains the function and operation of controls and equipment with which the pilot should be familiar. The location of the various items is illustrated and referenced in Fig.1 to 3 the numbers in brackets in the text being the reference numbers. (Fig.1 Nos. 1 to 17. Fig.2 Nos. 18 to 67, Fig.3 Nos. 68 to 87).

AEROPLANE CONTROLS

2. Flying and wheel brake controls:- The handwheel (34) incorporates a brake operating lever connected to the brake differential unit and provided with a catch for parking purposes. Each rudder pedal (20) is independently adjustable for leg reach in flight, adjustments being made with the toe.

3. Trimming tab controls:- The elevator trimming tabs are controlled by a handwheel on the left-hand side of the seat. The rudder trimming tab control box is fixed to the cockpit roof. For lateral trim, a tab is incorporated in the port aileron and is controlled by a small handwheel on the lower right-hand side of the main instrument panel (61). The elevator tab indicator is below the window rail against the pilot (8) and the rudder and aileron tab indicators are incorporated in the respective control units. The tabs are also arranged to provide automatic balance during operation of the control surfaces.

4. Flying controls locking gear:- The locking gear, for which stowage is provided in the rear fuselage, locks the primary flying controls in their neutral position, see Fig.4. The rudder pedals are locked by a spool that fits between the two pedals and is secured by a wing nut. The spool is connected to the control column locking tube by a cable so that one cannot be removed without the other.

HYDRAULIC CONTROLS

5. Two pumps, one on each engine, together supply hydraulic power for the operation of the undercarriage, main plane flaps and bomb doors.

6. Hydraulic hand pump:- The hydraulic hand pump is mounted on the floor beneath the pilot's seat and is operated by a detachable handle stowed in clips on the floor under navigator's seat. The pump may be used for operating the undercarriage and tail wheel, main plane flaps and bomb doors, through the normal hydraulic system, on the ground or if the engine-driven pumps fail during flight. The approximate time taken to lower the undercarriage by the hand pump is 4 mins.

7. Undercarriage control:- Raising and lowering of the undercarriage and tail wheel are controlled by the centre lever on the hydraulic control box (59). Before the UP position can be selected, the automatic safety catch on the lever must be released. At the end of an operation, the lever should return automatically to neutral but may sometimes return prematurely. This should be evident from the position indicator (see para.8) and the lever should then be held in the operating position until it is certain that the undercarriage and tail wheel are home. Conversely, if the operating lever fails to return to neutral although it is certain that all the units are home, it should be returned to neutral by hand.

8. Undercarriage position indicator:- The undercarriage position indicator is mounted at the centre of the main instrument panel, (36). The switch operating the indicator is interconnected by a link with the main ignition switches, compelling it to be on while the latter are switched on. All the lamps have dimmer screens for use during night-flying. The lamps operate as follows:-

Undercarriage fully retracted	- No light
Undercarriage between UP and DOWN locks	- Two red lights
Undercarriage fully lowered	- Two green lights

When the undercarriage is being lowered, each red lamp is extinguished only when the corresponding undercarriage unit is locked "down". Thus, in case of failure of one or both green lamps, the fact that the red lamps are extinguished indicates that the units are down and it may be checked that they are safe for landing by using the hand pump.

9. Undercarriage warning horn:- The warning horn, situated behind the navigator's seat sounds if the undercarriage units are not both safe for landing when both throttles are more than three-quarters closed.

10. Undercarriage EMERGENCY operation:- In the event of complete failure of the normal hydraulic system, indicated by failure of the method described in

para.6 the main wheels may be lowered but not raised by the following methods:-

(i) Push down the emergency system selector valve situated at the right-hand side of the pilot's seat and marked PUSH FOR EMERGENCY.

(ii) Operate the hand pump.

This method will not operate any other hydraulic service.

11. If all methods to lower the undercarriage have been attempted and the undercarriage indicator shows that the "down" locks are not properly engaged or, in the event of complete failure of the indicator this is suspected, it should be ascertained whether pressure can be maintained in the lowering jacks. In the case of the normal system, this will be confirmed by the undercarriage selector lever automatically returning to neutral or by considerable resistance felt towards operation of the hand pump, should this be necessary; the latter is also the test of pressure in the jacks for the emergency lowering system. Providing this pressure is continuously maintained by either the engine-driven or hand pump and, in the case of the normal system, the selector lever is held DOWN, it should be possible to make a satisfactory landing although the "down" locks are defective. The use of brakes in this instance should, if possible, be avoided and pressure should be maintained until the units can be locked by the ground staff after which flaps may be raised (see para.12).

12. Undercarriage ground locking:- In addition to the automatic locking device on the undercarriage retracting jack, a positive means of locking the latch on the retracting jack on the ground is provided, see fig.7. The dust cap, Part No. Q.9838, which covers the end of the locking latch is removed and replaced by the ground lock cap, Part No. Q.9846, with a red flag attached. It must be ensured that these locks are removed before flight; when not in use, the dust or locking caps are stowed in a canvas bag in each wheel well.

13. Main plane flaps:- Operation of the flaps is controlled by the lever (60) marked 'F' to the right of the undercarriage control lever. It should automatically return to NEUTRAL on completion of a full operation. Any flap angle can be obtained by returning the lever to NEUTRAL position when the desired angle is reached according to the flaps position indicator (37) which is situated next to the undercarriage position indicator.

14. Bomb doors:- Operation of the bomb doors is controlled by the cranked lever (58) marked B to the left of the undercarriage control lever. It should automatically return to neutral on completion of an operation. During flight it is important to see that the trailing aerial is retracted before opening the bomb doors.

ENGINE CONTROLS

15. Throttle and mixture controls:- The throttle control levers (12) and a single mixture control lever (4) are mounted in a control box on the pilot's left; the unit also carries the airscrew control levers (14) and the switches operating the two-speed supercharger (5) and air-intake filter control.

16. Auto-boost and slow-running cut-out controls:- An automatic boost cut-out control (35) is provided on the left-hand side of the instrument panel. A slow-running cut-out control is mounted on the fuel cock control panel.

17. Airscrew speed controls:- The speed control levers for the Hydromatic fully feathering airscrews are of normal type. The feathering control push-switches (54) are fitted on the bottom centre of the right-hand instrument panel.

18. Two-speed supercharger control:- The supercharger is automatically changed into high gear by an aneroid-operated switch when the aeroplane has reached an altitude of about 14,000 feet, when the switch on the side of the control box in the cockpit is set to the position marked AUTO. For take-off purposes the switch should be set to the low gear position marked MOD. until the aeroplane is air-borne. Low gear can be selected above 14,000 feet by moving the switch to MOD.

19. Coolant radiator shutters:- The shutters are controlled electrically by two switches, one for each radiator shutter, marked OPEN and CLOSED, on the right-hand instrument panel (47).

20. Fuel cock controls:- Two controls for the main fuel cocks are mounted on the navigator's seat back behind the pilot. Each cock has three control positions, OUTER TANKS, OFF and MAIN SUPPLY. In the OUTER TANKS position, the supply is taken from each pair of outboard tanks. In the MAIN SUPPLY position, the supply is taken from each pair of inboard tanks and the centre pair of tanks. The contents of the long-range tanks, if fitted, are fed to the collector box normally fed by the inboard and centre tanks by an immersed pump. The pump switch is on the right-hand instrument panel.

21. Normally the outboard tanks are selected for take-off. The fuel cock controls are then turned to MAIN SUPPLY. The outboard tanks should normally be used last. Fuel cocks should not be turned to MAIN SUPPLY below 500 feet, see Fig.5.

22. Fuel contents gauge:- Three twin fuel-contents gauges are mounted on the right-hand side of the cockpit (74, 75, 81). The forward gauge gives the fuel contents of each pair of outboard tanks, the central one that of the centre pair, and the rear one that of each pair of inboard tanks. The gauges are brought into operation by the switch linked with the main ignition switches.

23. Priming system:- A Ki-gas induction priming pump is fitted to each engine nacelle. During priming, the main fuel cocks should be turned to OUTER TANKS.

24. Fuel tanks venting control:- The fuel tanks are provided with automatic air pressure regulation to reduce fuel vapourisation at altitude by means of aneroid-operated valves connected to the pressure side of the starboard suction pump. In the event of a fuel tank leaking, a changeover cock above the fuel cock control panel, enables this regulation to be cut-out and the tanks vented directly to atmosphere.

25. Engine-starting ignition boost control:- Two push-switches, operating booster coils in the respective engine ignition systems, are provided on the instrument panel above the ignition switches for use during starting.

26. Air intake filter control:- Aeroplanes for operating under tropical conditions are fitted with air intake filters operated by a switch on the engine control box. When the switch is pressed up the air intake is normal and when pressed down the filter is in action.

27. Auxiliary oil tank:- If long range fuel tanks are fitted an auxiliary oil tank will be fitted in the rear of the fuselage near the wireless mast and two pipes are each led from this tank to the main tanks in the rear of the engine nacelles through ON – OFF cocks situated on the front spar behind the pilot's seat.

28. Suction pump change-over:- The instrument-flying panel is operated by both engine-driven suction pumps together and the installation is so arranged that, in the event of one pump breaking down, it is automatically isolated from the suction system.

OPERATIONAL EQUIPMENT

29. Signalling switchboxes:- The signalling switchbox (82) at the right-hand side of the cockpit provides for independent or simultaneous use of the upward and downward identification lamps through the morsing key or alternatively a steady illumination from either or both lamps. The three-position head lamp switch (80) above the watch holder, enables the head lamp to be in circuit with the downward identification lamp and to be used in conjunction with these for steady illumination or signalling. The rear signalling switchbox (83) provides for morsing or steady illumination from the formation keeping lamps; on this switchbox the DOWN switch only should be used.

30. Signal pistol:- A signal pistol is fixed to a bracket in the centre of the cockpit roof above the pilot's head; stowage for ten cartridges (68) is provided at

the right-hand side of the cockpit below the camera selector switchbox. There is also stowage for six more cartridges at the left-hand side of the bomb sight compartment.

31. Landing lamps:- Two landing lamp switches (24) are positioned on the bottom centre of the instrument panel, and are marked OFF, LOW BEAM, HIGH BEAM. The first few aeroplanes are fitted with Grimes landing lamps No.1220B and it will only be necessary to use the OFF and HIGH BEAM position on the switch. If the J type lamp is fitted, the full switching range may be used.

32. Windscreen de-icing control:- De-icing fluid can be sprayed on to the windscreen from a nozzle mounted in front of it. The supply is controlled by a small hand pump (63) with a regulator mounted immediately below the aileron trimming tab control.

33. Oxygen equipment:- A standard oxygen regulator unit (22) is fitted to the instrument panel to the left of the hydraulic selector box, and one for the navigator on the right-hand side below the fuel gauges (70). Two economizer units with a length of tubing for the low pressure supply to the oxygen masks are located beneath the cockpit floor. A high-pressure control valve is provided next to the navigator's regulator and controls the supply for both pilot and navigator. Portable oxygen outfits are provided at the right-hand side of the bomb sight compartment (57).

34. Bombing:- The bomb release switch for the pilot's automatic selector switch is at the top left-hand side of the fuselage near to the instrument panel (10). The manual control for jettisoning the bombs is on the left-hand side of the aileron trimming control (62). The bomb container jettison switch is on the bottom right-hand corner of the instrument panel (18).

MISCELLANEOUS

35. Cockpit entrance hatch, etc. Entrance to the cockpit is gained through a hatch in the forward underside of the fuselage; a folding ladder for use with this entrance is stowed beneath the cockpit floor. The hatch is opened from outside by a square key and from inside by the door handle. There is a further door in the cockpit floor which hinges up against the fuselage side and engages with a catch; this door must be opened before the main door can be opened (see also para.44).

36. There is a similar hatch on the starboard side of the fuselage aft of the wing, which is opened from the outside only. It provides access into the fuselage for inspection, changing accumulators and oxygen cylinders, installing camera, etc.

37. Pilot's seat:- The seat is adjustable for height by means of a lever on the left-hand side (17). The harness release gear is operated by a lever at the right-hand side of the seat (65). Downward movement of the lever releases the harness shoulder straps, enabling the pilot to lean forward. The harness must be re-locked by the lever when the normal sitting position is resumed.

38. Windows:- The two front corner windows are hinged and can be opened inwards. (9) (77).

39. Cockpit lighting:- A roof lamp is provided above the pilot's head and has a knurled cap which is rotated to switch it on and off. A floodlamp and dimmer-switch are provided at the left-hand side of the pilot to illuminate the compass and instrument panel.

40. Heat and ventilation:- A lever for controlling cockpit ventilation is mounted on the right-hand side of the cockpit (40). An adjustable ventilator is also mounted at the left-hand side of the cockpit (11) forward of the pilot. The heating control is behind the pilot's seat.

41. Thermos flasks:- Provision is made for carrying four thermos flasks at the left-hand side of the bomb sight compartment.

42. Sanitary funnel:- A sanitary funnel and tank are stowed beneath the pilot's seat.

43. Picketing equipment:- The picketing equipment is stowed in the rear fuselage compartment, against the side.

EMERGENCY EXITS AND EQUIPMENT

44. EMERGENCY exits:- See fig.6. The pilot's entrance hatch is also used as a parachute exit for the crew and is made jettisonable for this purpose. To jettison the hatch, the floor door is opened and the pedal at the left-hand side of the hatch pressed.

45. An emergency exit for use in the event of a crash landing etc., is fitted in the cockpit roof and is operated by pulling down the red-coloured lever and pushing out the panel.

46. Fire extinguishers:- The Graviner-type fire extinguisher system, is operated by two push-switches on top of the fuel gauges panel at the right-hand side of the cockpit (76). The forward switch operates the port engine extinguisher and the rear switch the starboard one. An impact switch in the bomb sight compartment, attached to the rudder pedals cover and flame switches in each engine nacelle provide automatic operation of this system. To guard against the possibility of fire or dangerously high temperatures in either engine working the flame

switches and operating the extinguishing system without the pilot's knowledge, two red warning lamps, one for each engine and mounted above the right-hand instrument panel (46), are wired to the extinguisher systems to indicate when either one operates.

47. Two hand fire extinguishers are provided, one beside the pilot and one on the rudder pedals cover in the bomb sight compartment.

48. Fireman's axe:- A fireman's axe (72), for cutting a way out of the fuselage in an emergency, is stowed on the right-hand side of the bomb sight compartment.

49. First-aid outfit:- A first-aid outfit is stowed beneath the pilot's seat.

50. Dinghy:- An inflatable dinghy is stowed above the wing centre section in a container secured within the fuselage, with the door on top. It is inflated automatically by an immersion switch or, manually, by a cable on the cockpit roof behind the pilot's head.

51. Navigator's parachute:- A lap-type parachute for the navigator is stowed forward of the instrument panel, in the front compartment.

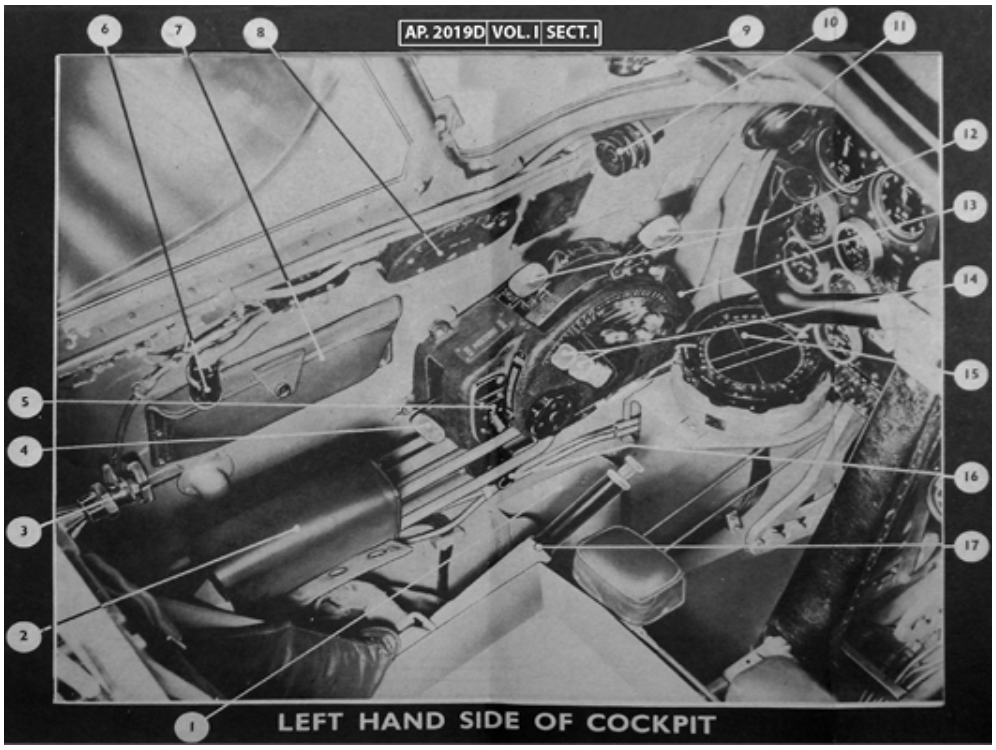

Fig. 1

KEY TO FIG. 1

1. Map Case
2. Pilot’s Arm Rest
3. Fire Extinguisher Bottle
4. Mixture Control Lever
5. Supercharger Switches
6. Pilot’s Intercommunication Plug
7. Pilot’s Pouch
8. Elevator Tab Trim Indicator
9. Securing Knob for Direct Vision Side Panel
10. Pilot’s Bomb Release Switch
11. Adjustable Ventilator
12. Throttle Control Levers
13. Compass Lamp
14. Airscrew Control Levers
15. Compass Type P.4A.

16. Compass Lamp Dimmer Switch
17. Pilot’s Seat Adjusting Lever

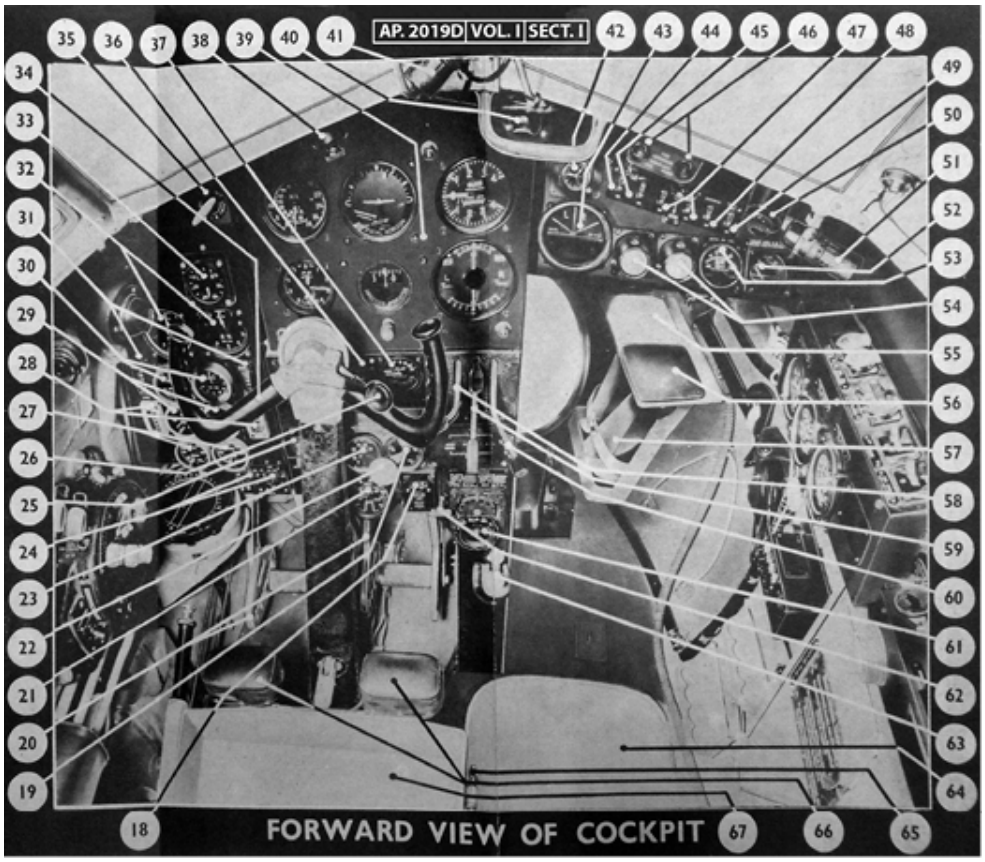

Fig. 2

KEY TO FIG. 2

18. Bomb Container Jettison Switch
19. Oxygen Contents Gauge
20. Adjustable Rudder Pedals
21. Brake Pressure Gauge
22. Oxygen Regulator
23. Altimeter
24. Landing Lamp Switches
25. Ignition and Electrical Service Negative Switches
26. Brake Lever
27. Coolant Temperature Gauges
28. Oil Pressure Gauges
29. Oil Temperature Gauges

30. Boost Pressure Gauges
31. Fuel Pressure Gauges
32. R.P.M. Indicators
33. Steering Indicator
34. Handwheel
35. Automatic Boost Cut-Out Control
36. Undercarriage Position Indicator
37. Flaps Position Indicator
38. Pilot’s Lamp Dimmer Switch
39. Blind Flying Instrument Panel
40. Ventilator Control Lever
41. Pilot’s Lamp
42. Time of Flight Clock
43. Visual D.F. Indicator
44. Navigation Lamps Switch
45. Pressure Head Heater Switch
46. Fire Extinguisher Warning Lamps
47. Coolant Radiator Shutter
48. Generator Switch
49. Fuel Pump Switch
50. Air Observer’s Dimmer Switch
51. Air Observer’s Lamp
52. Voltmeter
53. Air Temperature Gauge
54. Airscrew Feathering Control Push Switches
55. Bomb Aimer’s Writing Tablet
56. Bomb Aimer’s Elbow Rest
57. Portable Oxygen Outfit Stowage
58. Bomb Doors Control Lever
59. Undercarriage & Tailwheel Control Lever
60. Flap Control Lever
61. Aileron Lateral Trim Control and Indicator
62. Bomb Jettison Switch
63. De-Icing Handpump and Regulator
64. Entrance Door
65. Pilot’s Harness Release Lever
66. Pilot’s Thigh Rests
67. Pilot’s Seat

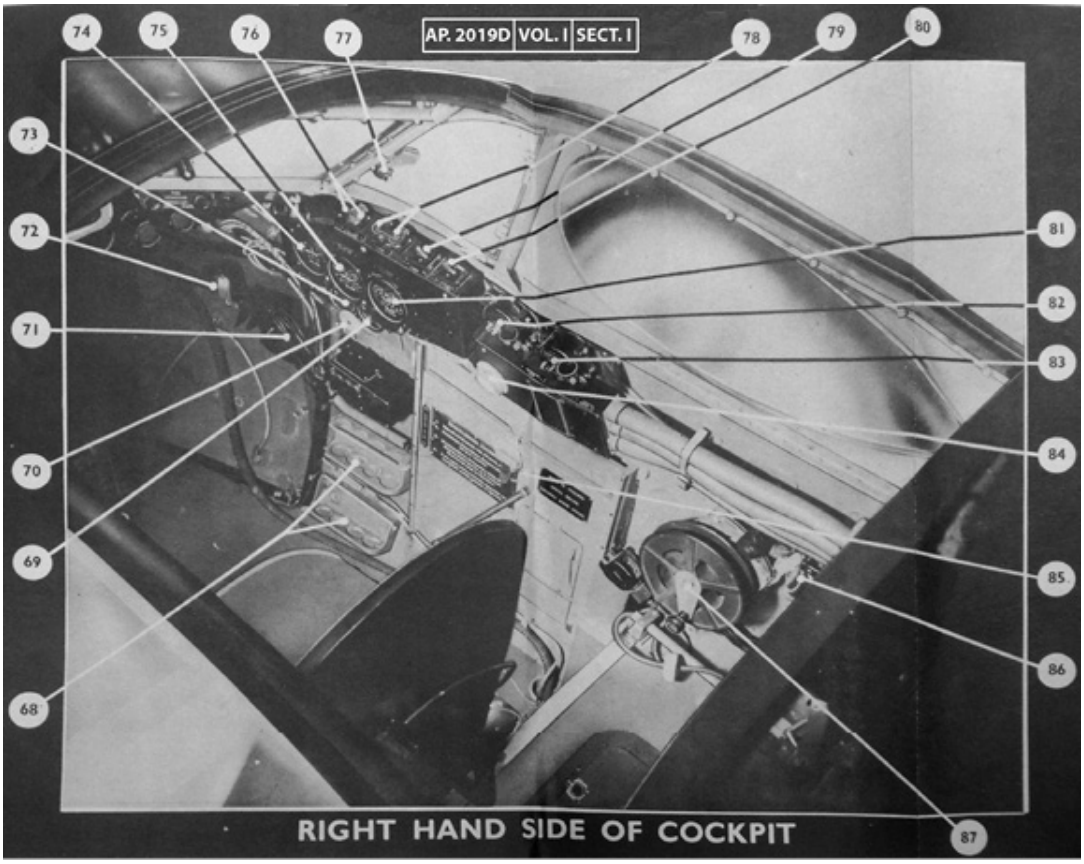

Fig. 3

KEY TO FIG. 3

68. Stowage for Very Light Cartridges
69. Oxygen Contents Gauge
70. Oxygen Regulator
71. Camera Leads Stowage
72. Fireman’s Axe
73. Altimeter
74. Fuel Contents Gauge (Outer Tanks)
75. Fuel Contents Gauge (Centre Tanks)
76. Fire Extinguisher Switches
77. Securing Knob for Direct Vision Side Panel
78. R.3003 Push Switches
79. R.3003 Switch

80. Navigation Headlamps Switch
81. Fuel Contents Gauge (Inner Tanks)
82. Identification Lamps Control Switch
83. Formation Lamps Control Switch
84. Watch Holder
85. Navigation Table
86. Observer’s Intercommunication Plug
87. Trailing Aerial Winch

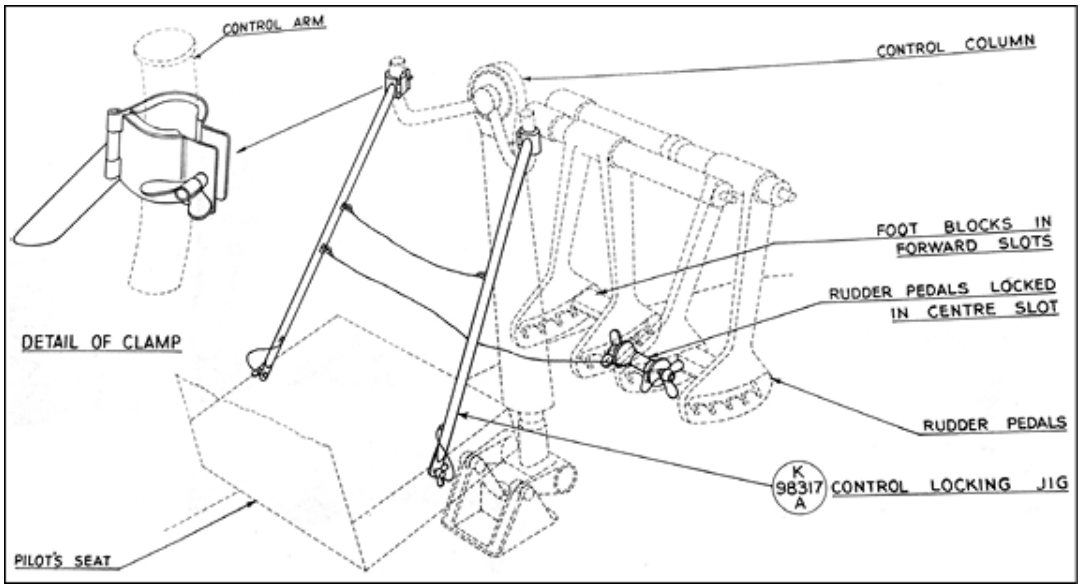

Fig. 4 Control locking jig

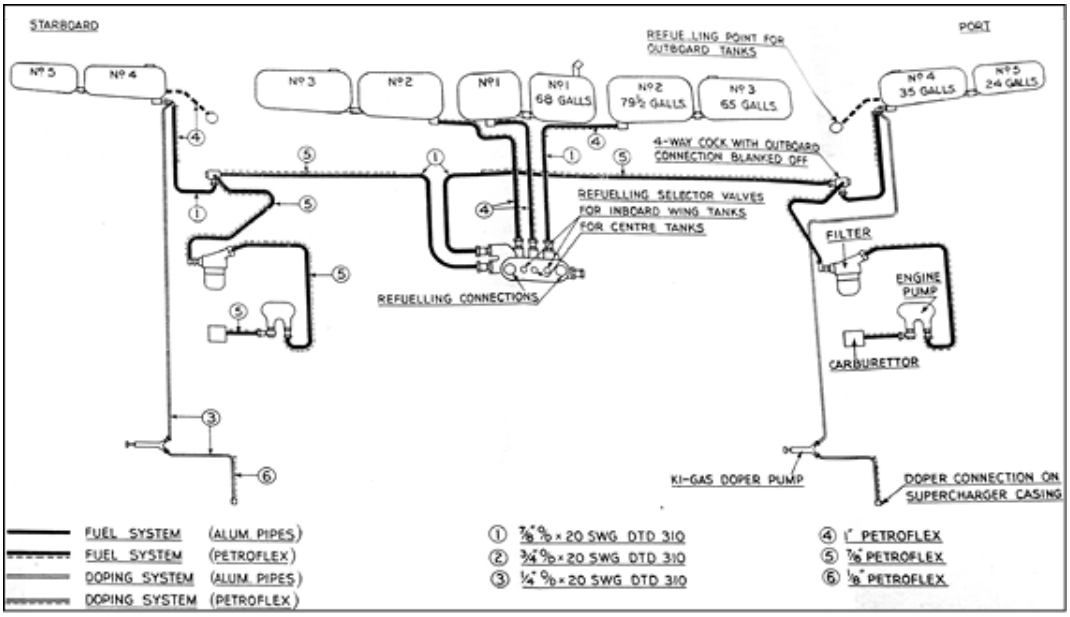

Fig. 5 Diagrammatic arrangement of fuel system

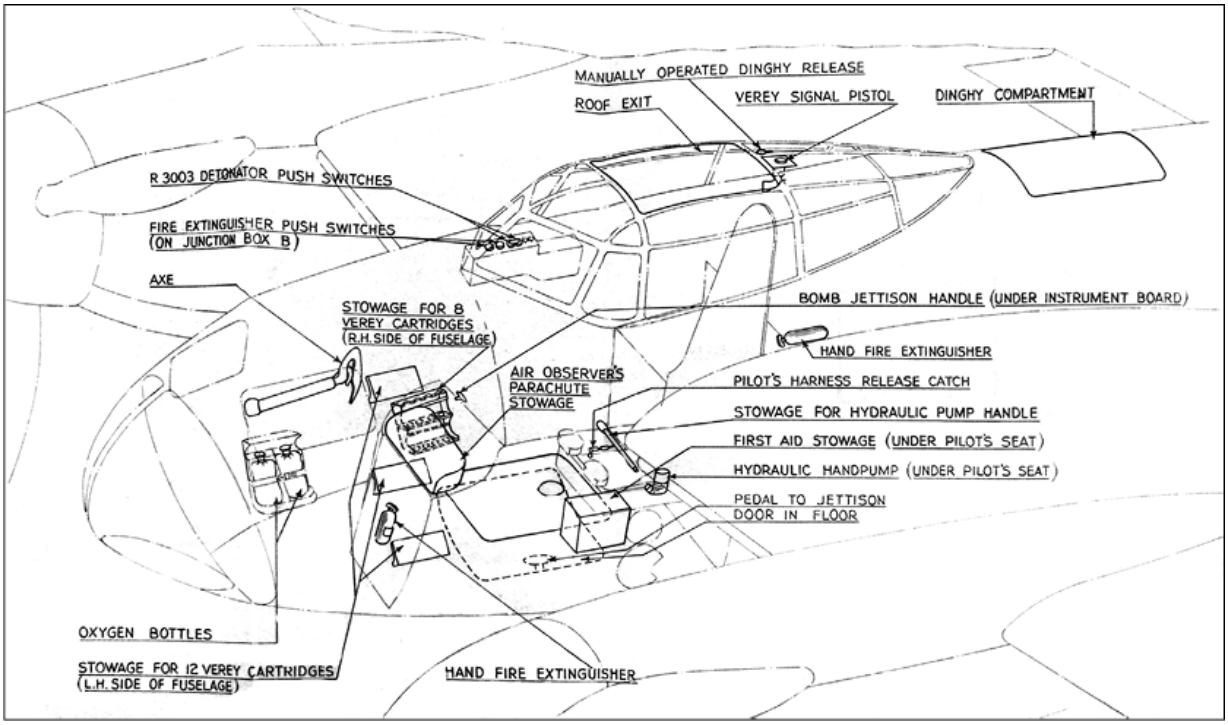
MANUALLY OPERATED DINGHY RELEASE
ROOF EXIT
VEREY SIGNAL PISTOL
DINGHY COMPARTMENT
R 3003 DETONATOR PUSH SWITCHES
FIRE EXTINGUISHER PUSH SWITCHES (ON JUNCTION BOX B)
AXE
STOWAGE FOR 8 VEREY CARTRIDGES (R.H. SIDE OF FUSELAGE)
BOMB JETTISON HANDLE (UNDER INSTRUMENT BOARD)
HAND FIRE EXTINGUISHER
AIR OBSERVER'S PARACHUTE STOWAGE
PILOT'S HARNESS RELEASE CATCH
STOWAGE FOR HYDRAULIC PUMP HANDLE
FIRST AID STOWAGE (UNDER PILOT'S SEAT)
HYDRAULIC HANDPUMP (UNDER PILOT'S SEAT)
PEDAL TO JETTISON DOOR IN FLOOR
OXYGEN BOTTLES
STOWAGE FOR 12 VEREY CARTRIDGES (L.H. SIDE OF FUSELAGE)
HAND FIRE EXTINGUISHER

Fig. 6 Emergency equipment

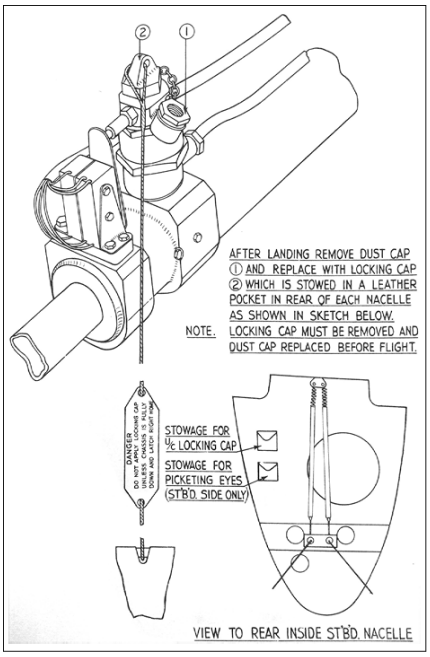
②
①
AFTER LANDING REMOVE DUST CAP ① AND REPLACE WITH LOCKING CAP ② WHICH IS STOWED IN A LEATHER POCKET IN REAR OF EACH NACELLE AS SHOWN IN SKETCH BELOW.
NOTE. LOCKING CAP MUST BE REMOVED AND DUST CAP REPLACED BEFORE FLIGHT.
STOWAGE FOR ½" LOCKING CAP
STOWAGE FOR PICKETING EYES (ST'B'D. SIDE ONLY)
VIEW TO REAR INSIDE ST'B'D. NACELLE

Fig. 7 Undercarriage locking cap

SECTION 2.

HANDLING AND FLYING NOTES FOR PILOT

Note:- The handling information here given applies to the early aeroplanes, which may be distinguished by shorter engine nacelles and smaller tailplanes.

ENGINE DATA.

1. (i) Fuel:- 100 octane only.
   Oil:- Key letter X/X
   Coolant: 70% water, 30% ethylene Glycol, Stores ref. No. 33c/559
   (ii) The principal engine limitations are as follows:-

	ENGINE		MERLIN 21	
	R.P.M.	Boost lb./sq.in.	Temp. Coolant outlet	°C Oil inlet
TAKE-OFF TO 1,000 FT.	3,000	+12		
CLIMBING ½ HR. LIMIT	M 2,850 S 2,850	+9 +9	120 (135) 120 (135)	90 (100) 90 (100)
CRUISING RICH	M 2,650 S 2,650	+7 +7	100 (115) 100 (115)	90 (100) 90 (100)
CRUISING WEAK	M 2,650 S 2,650	+4 +4	100 (115) 100 (115)	90 (100) 90 (100)
ALL OUT 5 MINS. LIMIT	M 3,000 S 3,000	+9 +9	120 (135) 120 (135)	95 (100) 95 (100)

Note:- The maximum oil and coolant temperatures shown in brackets are to be used as combat concessions only. Oil temperature under these conditions may be

105 °C for 15 minutes.

OIL PRESSURE:	NORMAL:	60 lb./sq.in.
EMERGENCY MINM.	(5 MINS.):	45 lb./sq.in.
MINM. TEMP. FOR TAKE-OFF:	OIL:	15ºc
	COOLANT:	60ºc

(iii) <u>The following limitations must also be observed.</u>Minimum r.p.m at +12 1b/sq.in. boost: 2,225

DIVING	Maximum boost	+9 lb./sq.in.
	Maximum r.p.m.	3,600
	3,000 r.p.m. may be exceeded only for 20 seconds, and with throttle not less than one third open.	

(iv) <u>Extension of limitations.</u>

The Following is permitted for short periods when necessary in operations. Each occasion must be reported and an entry made in the engine log book.

All-out, in M gear only: +12 lb./sq.in. boost, obtained by operating the boost control cut-out.

(v) Fuel pressure:- 6 to 10 lb./sq.in.

FLYING LIMITATIONS

3. Maximum speeds in m.p.h. I.A.S

Diving	360
Bomb doors open	No limit
Undercarriage	180
Flaps down	150

PRELIMINARIES

3. (i) Check that the EMERGENCY selector knob, marked PUSH FOR EMERGENCY is in the up position and its safety catch engaged.

(ii) Check that the undercarriage selector is at NEUTRAL, and its safety catch properly engaged.

(iii) See that the undercarriage Jack locking caps are removed and stowed in the aeroplane.

(iv) Set cooling switch to OPEN and check that radiator shutters open.

STARTING THE ENGINES AND WARMING UP

4. (i) Set fuel cocks to OUTER TANKS.

(ii) Set controls as follows:-

(a) Throttles	- ½ inch open
(b) Mixture control	- RICH
(c) Airscrew speed controls	- Fully forward
(d) Superchargers	- MOD
(e) Cooling switch	- OPEN
(f) Ignition switches	- ON

(iii) The ground crew will operate the priming pumps until the suction and delivery pipes are primed; this may be judged by a sudden increase in resistance. The number of strokes of the priming pump which must then be given while the engine is being turned, before it may be expected to start when cold is as follows:-

Air Temperature °C	+30	+20	+10	0	–10	–20
Number of strokes	3	4	7	13	30	60

(iv) Press the starter and booster coil buttons, while the ground crew are priming the engine as rapidly and vigorously as possible. The engine should start without greatly exceeding the above number of strokes, or after not more than two if the engine is hot. Turning periods must not exceed 20 seconds, with at least a 30 seconds interval between them.

(v) At temperatures below 0°C it may be necessary for the ground crew to continue priming after the engine fires until it picks up on the carburettor.

(vi) Release the starter button, and when the engine is firing steadily, release the booster coil button. The ground crew will screw down priming pumps and close the priming pump panels.

TESTING ENGINES AND INSTALLATIONS.

5. After warming up:

(i) Check the operation of each engine-driven hydraulic pump by lowering the flaps with one engine opened up to 2,000 r.p.m. and raising them with the other engine 2,000 r.p.m. Failure of one pump is indicated by sluggish movement in one direction on the power supplied by the idling engine.

(ii) Open up to weak mixture cruising boost and check the operation of the airscrew.

(iii) Test each magneto in turn at rich mixture cruising boost. The drop should not exceed 150 r.p.m.

(iv) Open the throttle to the climb position and check boost.

(v) Open the throttle fully, and check boost, oil pressure and static r.p.m. (2,950 to 3,000).

TAXYING.

6. (i) Check that brake pressure is at least 200 lbs./sq.in.

(ii) It is important that the flaps be kept fully up.

FINAL PREPARATIONS FOR TAKE-OFF.

7. If desired 25º of flap may be used for the take-off. If used, the lowering of the flaps should be done after clearing engines and turning into wind, and with both engines throttled to the same idling speed. Set flap selector to UP and allow it to return to NEUTRAL. Then set it to DOWN; return it to NEUTRAL when the indicator shows 25º.

T – Trimming tabs	- All Neutral
M – Mixture	- RICH
P – Pitch	- Airscrew speed controls fully forward.
Fuel	- Check contents and cocks to OUTER TANKS.
Flaps	- UP, or 25º down. Do not open up engines separately after setting flaps down.
Superchargers	- MOD
Radiator cooling switches	- OPEN.

TAKE-OFF

8. (i) Open both throttles slowly to take-off position. Maintain right rudder as necessary to check the tendency to swing to port, and raise the tail by a light forward pressure on the control column.

(ii) Check that the undercarriage locks up; if the indicator lights do not go out, return the selector to UP.

(iii) Do not start to climb until the safety speed of 170 m.p.h. I.A.S. is reached.

(iv) Before raising the flaps (if used), trim the aeroplane slightly tail heavy.

(v) If climbing to high altitude, set supercharger gear control to AUTO.

(v) Change over to inboard wing and centre fuel tanks by setting cocks to MAIN SUPPLY. If the fuselage tanks are in use, switch on the immersed fuel pump.

(vi) If for any reason the green lights remain on, hold undercarriage selector lever DOWN for 5 seconds before landing to ensure that the tail wheel is down.

CLIMBING

9. (i) The speed for maximum rate of climb is 175 m.p.h. I.A.S. up to 12,000 feet and 170 m.p.h. I.A.S. from 12,000 to 20,000 feet. Above 20,000 feet reduce speed by one m.p.h. per thousand feet.

(ii) Normally the fuel tank pressure venting control should be set to OFF (i.e. venting to atmosphere): but when climbing to high altitudes in summer or under tropical conditions, the control should be set ON.

GENERAL FLYING.

10. (i) Stability – The longitudinal stability is neutral in level flight, but the aeroplane is unstable when climbing, and markedly unstable when gliding with the C.G. aft.

(ii) Change of trim:-

Undercarriage up	Nose up slightly.
Flaps up	Nose down sharply.
Radiator shutters open	Nose up.
Bomb doors open	Little change.

(iii) Economical cruising –

(a) At 19,000 lbs. the recommended speed for greatest range, level, climbing or gliding is 200 m.p.h. I.A.S.

(b) The supercharger gear control should only be set to AUTO if the use of the higher gear is necessary.

STALLING.

11. (i) The approximate stalling speeds at 18,050 lbs. are –

Flaps and undercarriage UP	122 m.p.h. I.A.S.
Flaps and undercarriage DOWN	112 m.p.h. I.A.S.

(ii) At the stall there is considerable vibrations and the nose drops followed by one wing, if the control column is held back. The stall is not violent, and control is quickly regained when the speed is increased.

MANOEUVRES

12. (i) Spinning and aerobatics are not permitted.
(ii) High accelerations are to be avoided.

APPROACH AND LANDING

13. (i) Reduce speed to 150 m.p.h. I.A.S., set radiator switches to OPEN, and carry out the Drill of Vital Action.

U	–	- DOWN
Undercarriage		Check by indicator that undercarriage and tail wheel are down.
M – Mixture		- RICH
P – Pitch		- Airscrew speed control fully forward.
Superchargers		- MOD.
Flaps		- Fully down.

(ii) Correct speeds for the approach.

Engine assisted	125 m.p.h. I.A.S.
Glide	140 m.p.h. I.A.S.
Engine assisted with flaps up	135 m.p.h. I.A.S.

(iii) The tail heaviness and reduction of elevator control when the flaps are lowered is very marked.

MISLANDING.

14. (i) Open throttles fully. Climb at about 140 m.p.h. I.A.S.
(ii) The flaps come up quickly, and should not be raised until a safe height has been reached. They should be raised in stages, and the aircraft trimmed tail heavy before raising them the last 20º.

ENGINE FAILURE DURING TAKE-OFF

15. (i) If safety speed has not been attained it is necessary to close both throttles and land straight ahead.
(ii) If safety speed has been attained, the aeroplane climbs easily on one engine. Close the throttle of the failed engine and feather its airscrew.

FLYING ON ONE ENGINE

16. (i) The aeroplane will easily maintain height on one engine, with the dead airscrew feathered, at +7 lb/sq.in. boost and 2,650 r.p.m. and will climb at about 180 m.p.h. I.A.S. The temperatures are likely to become

excessive if +7 lb/sq.in. boost is used for long at 170 m.p.h. I.A.S. The radiator shutter on the live engine must be OPEN.

FEATHERING

17. (i) Press feathering button and let go.
(ii) Close throttle immediately.
(iii) If single engine flying is to be continued for any length of time, switch off and turn off fuel.

UNFEATHERING

18. (i) Set airscrew speed control fully back.
(ii) Turn on fuel and ignition (if off).
(iii) Press feathering button until r.p.m. reach 600 to 800. Release the button, and leave engine to windmill until warm. If the r.p.m. rise further, they can be reduced by pressing the feathering button momentarily and pulling it out again.
(iv) When engine is warm, press button and hold it in. The airscrew will feather and then immediately unfeather. Release button when r.p.m. have risen to 1,500. The airscrew will then return to normal constant-speed operation.

NOTE:- If the engine is still warm, the warming up stage can be omitted. Press button and hold it in until r.p.m. reach 1,500.

CORRECTION FOR POSITION ERROR.

19. The correction for position error at 18,400 lb. are:-

I.A.S. m.p.h.	Correction
165	Zero
285	Subtract 2 m.p.h.
315	

FUEL CAPACITY AND CONSUMPTION

20. (i) The effective fuel capacities are:-

4 outboard wing tanks	116 gallons
4 inboard wing tanks	287 gallons
2 centre tanks	136 gallons
	539
Fuselage tanks (if fitted)	151 gallons

(ii) The approximate fuel consumptions per engine are:-

Mixture	r.p.m.	Boost lb/sq.in.	Gallons/hour per engine
RICH	3,000	+12	about 125
RICH	3,000	+ 9	103
RICH	2,850	+ 9	98
RICH	2,650	+ 7	82
WEAK	2,650	+ 4	54
WEAK	1,800	–1 ½	32

(iii) When the fuselage fuel tanks are fitted and the immersed pump is switched on, with the fuel cocks set to MAIN SUPPLY, the engines are fed from the fuselage tanks. If the contents of the inboard and centre tanks fall under these conditions, a stoppage of the supply from the fuselage tanks is indicated. This may be due to:-

(a) Fuselage tanks empty.

(b) Failure of pumps.

(c) At high altitudes the pressurising of the inboard and centre tanks may raise the pressure in these tanks so that fuel is fed from them instead of from the fuselage tanks. To restore the supply from the fuselage tanks the pressure venting control may be set OFF.

OIL CAPACITY.

21. The normal effective oil capacity is 30 gallons, in two tanks in the engine nacelles. In addition, if the fuselage fuel tanks are fitted, a single oil tank is fitted in the fuselage having an effective capacity of 10 gallons. The cocks admitting oil from this tank to the nacelle tanks should be turned on when 550 gallons of fuel have been consumed.

CHAPTER III
Tactical/Operations

SECRET

SOME ASPECTS OF OPERATING MOSQUITO NIGHT BOMBERS

The time has come for someone to write and try to analyse the psychological, physical and morals aspect of the crews and the method of operation of bombers over Germany, and since my arrival in this squadron I have had an excellent opportunity of comparing these various factors in their relation to Mosquito aircraft and to heavy bombers.

I am convinced that the two are quite dissimilar and that if the type of operation undertaken at present by this squadron is to be extended to any other squadron or undertaken in any other type of aircraft, then a much more serious study of the subject must be made.

The factors in heavy and light bomber operations that have a direct bearing on the efficiency of the crew, are the latter's confidence in their aircraft and its case of flying, physical fitness and the reduction of extraneous worries as to domestic and private affairs to a minimum.

So far in this war there appears to have been little set policy regarding the physical and psychological aspects even of selecting aircrews. It would appear that from the start a number of young men have been taken from their civil life and trained, each in their various duties, rather briefly and with a mass of others.

They have been required to operate against Germany in aircraft ranging from the very good to the highly indifferent, without the slightest regard to that psychological factor alone.

There has been a marked tendency in Bomber command to send only the best crews to the best aircraft and though this may have some justification

in directions beyond the scope of this paper, it would seem, logically, incorrect. Thus when the Halifaxes were introduced it was considered at the time that those crews obtaining the highest qualifications at O.T.U's should, as a reward, operate in these aircraft. When however, it became apparent that the Halifax as it was then produced, was as good a coffin as was ever made on the ground, then the flow of the cream of Bomber command became somewhat sluggish.

To treat this particular case logically, the best crews certainly should not have been sent to the best aircraft, on the assumption that it requires more skill and ability to be successful with indifferent weapons than otherwise. Thus the indifferent crews should have been given the better aircraft and conversely.

On the introduction of the Lancaster with which one Group alone was for a long time favoured and which continued to undertake for a considerable period the more spectacular type of operations, there formed almost a corps d'elite, and though this served that Group well it tended to have some adverse effect, it is thought, on the crews posted to Stirlings and to Halifaxes.

To apply this broad argument to the type of operations being carried out by this Squadron, it is necessary to divide the subject into eight parts and to try to examine each carefully to see if there is any way in which we can (a) improve the breed (b) better train the crews for the type of aircraft and operations, and (c) obtain some sort of information on the reasonable length of tour and the strain and effects of the type of operation.

During the past four months 139 Squadron has been called upon to operate occasionally with the main force but generally alone, in conditions of weather in which none but the really skilled would ever attempt to fly, and against targets in Germany endowed with the heaviest defences.

(i) <u>AIRCRAFT</u>

Aircraft capabilities and the limits to which they can be put and, in other words, the Pilot's confidence in his aircraft, plays a considerable part. In the Mosquito there is a fast, highly manoeurvreable aircraft with no real vices. It is also an aircraft with which one can take no liberties from the moment of starting the engines to that of stopping them. It requires in the air constant attention and concentration to fly it accurately because of its quick

response, light controls and high speed. There is thus not a moment of relaxation from the time of leaving the ground to returning to it. The settings of the throttles and engines for instance, give a fast tick-over and this, in such a small aircraft is conducive to fast taxying, the first cause of accidents. On take-off the aircraft will swing easily and quickly get out of control if it is allowed to and though there is no vice in this it means that the Pilot must concentrate quite considerably if he is to avoid this particular form of trouble. After take-off the instruments (artificial horizon and altimeter) give false readings for the first few hundred feet and an inexperienced pilot in taking-off in conditions of bad visibility of cloud could quite easily get into trouble this way.

In the air the aircraft is straight forward and normal and though there is a certain instability at the height of about 20,000 feet with a full load, there is little cause for worry in the aircraft's flying characteristics.

In bad weather, however, rain cloud, bumpy conditions and when compelled to fly close to the ground at night to avoid low cloud or ice, the aircraft is far from easy to manage. In cloud, and as this squadron is required to fly extensively in cloud, and sometimes in cumulonimbus, the aircraft leaps about to such an extent that the instruments become blurred and the Navigator is in danger of knocking his brains out on the roof unless he is strapped in.

As with other types, airspeed and rate of climb fluctuate wildly and the only really useful instrument at these times is the artificial horizon. The aircraft is not easy to fly then and it is my opinion that at least seven of our casualties have been due to this cause, which sums up to lack of instrument flying and an incomplete knowledge of bad weather and flying by night. As these casualties occurred it was possible to watch and expect them merely by noting these that had little night flying experience, only just average skill and of a somewhat nervous disposition. I made a mental note of the names of these crews sometime ago and they are now all missing.

If any comparison is to be made between heavy aircraft and Mosquitos the greatest single contrast is probably that of the stability and flying skill required for the different types. In the Mosquito there is a relatively unstable aircraft, quick to response, fast, highly manoeuvrable and difficult to fly on instruments. In the "heavy" there is a somewhat slower, sluggish and more stable aircraft that can actually be left alone if properly trimmed,

for very considerable periods; added to this, the Heavies are invariably equipped with the Automatic Pilot; the Mosquito, of course is not.

(ii) Weather

The weather on many of the nights on which this Squadron has been called to operate, has in reality demanded a particular type of bad weather flying ability and as far as I am aware no previous training for this had been given. Aircraft have been sent out in rain and fog and in a visibility of less than 1,000 yards, a cloud base of down to 500 feet with the tops at 20,000 and over, as a regular thing. They have also been required to fly in conditions of high turbulent cloud, cumulonimbus on occasions up to 35,000 feet, above the ceiling of the aircraft, and on other occasions where there were layers of stratus at their operating height which effectively masked cumulonimbus from vision so that the chances of flying into a high top unwittingly were considerable.

Ice in the winter is always a bogey and whereas a skilled pilot with considerable knowledge of ice conditions and the liberties that can be taken, is seldom worried, the average Heavy bomber pilot is worried by the mere thought of ice, in many cases due to ignorance. The Mosquito, from the little evidence that is now available (and as this comes from Boscombe Down, it should be treated with much reserve) is operationally not very susceptible to ice because of its speed and power reserves and because of these the aircraft in the right hands can be kept out of trouble. On the other hand, in conditions of severe ice in the cold sector of a warm front or conditions of glazed ice, it is affected much more rapidly than its bigger brother. De-icing paste is not used.

In addition to having to fly through bad weather on going to a target, there is the possibility of having to return through it back to base, and this factor has a far greater effect than the first. It is much more difficult to return through bad weather and get down below the ice level without hitting the ground in the winter, than it is merely to take off on instruments and fly straight through the ice at full power.

If, on descending, the aircraft unwittingly flies through an ice layer it may accumulate more ice than is safe before the pilot realises it, and fly straight into the ground. Unless the pilot regulates his rate of descent very carefully to take him through the ice layer in a shorter time than that required for the

serious icing of his aircraft, then he is likely to get into trouble. Apart from ice, the danger of inadvertently flying into cumulonimbus is always present and though there is no direct evidence of the effect of this type of cloud on a Mosquito, there has been a significantly high number of casualties when cumulonimbus clouds have been present. It is interesting to recall that the first E.F.T.S. rule to embryo pilots is that on no account at any time by day or night, must they fly into these clouds.

The psychological effect of isolated flying over Germany knowing that the battle is only half over after leaving the Dutch Coast and that there is bad weather at Bases and all over the country, often a cloud base of 400 feet and tops 15,000 – 20,000, has to be taken into account. There is no doubt that it is not comforting to crews to be told at briefing in the cold winter months that they will have to return through cloud to get home, extending from 500 feet to 24,000 feet, with high icing in certain sections of it.

In addition to this the Mosquito is not, as I have previously said, a good bad weather aircraft. In rain the windscreen becomes very blurred and the clear vision panel does not really allow enough forward vision. The aircraft is so very sensitive fore and aft that it needs considerable attention to avoid flying into the ground when descending through cloud at night; when flying at a height of between three hundred and five hundred feet, the slightest error and the slightest touch on the controls may cause trouble.

(iii) ENEMY DEFENCES

The next subject is small in its material aspect though large psychologically; it is the effect of being alone over a heavily defended area. The effect is nearly all psychological though many of my aircraft have been hit repeatedly and on one or two occasions returned with one engine failed and the other engine also hit. I do not think however, that the casualty rate has much to do with the ground defences provided that the standard of crews is maintained at the highest possible level, our tactics changed continuously and that nothing further is done to impair the performance of the Mosquito.

This latter point requires emphasis. There is now good evidence to show that a first class pilot, with previous knowledge of German defences, intelligent and quick, flying a Mosquito in the way this squadron is required to do has only a small risk of being shot down. Another pilot, not quite so

skilled, not quite so quick and not quite so knowledgeable, however little, can be allotted his span in direct relation to his qualities of skill, intelligence and alertness.

The Ruhr is one of the most heavily defended areas in Germany but at the present time Berlin is probably the heaviest. The Berlin target was not of a high priority and when only Mosquitos could get there in the hours of darkness, it is my opinion that the Ruhr was relatively much more heavily defended. It is interesting to note however that the Crews in this Squadron would infinitely Ruhr trip than they would one to Berlin, though the reaction of the Berlin defences has steadily increased from first starting there when there was no reaction, at the time in question they were no heavier than they were in the Ruhr.

In the Main Force, there is considerable comfort I think to be derived from the fact that one is one of many and the knowledge that there are one's friends also flying not far away, maybe just ahead, being shot at or coned by searchlight. The knowledge that there are several other hundreds of crews in the same relatively small piece of sky at the same time as oneself is comforting. There is this in favour of the Main Force type of operation – a privilege which Mosquitos seldom enjoy.

Up to the present Mosquitos have varied in numbers up to six on each target at one time, though on one occasion there were eight Mosquitos over Berlin. The rule is more often that of one or two or three getting to the target at the same time and in my opinion the fact that each one of these crews realises that they may be entirely alone to receive the concentrated attention of the defences is a strong factor in their reactions to this type of operation. In order to reduce this effect I introduced a scheme of inter-communication between aircraft on VHF whilst over the target.

In conjunction with this must be considered the fact that the Mosquito crew is only two. The Navigator is a very busy man and the pilot is not able to relax for more than a few seconds at a time. In the Main Force Heavies there are crews of six and seven, usually friends with some things in common and at the least some of the same experiences together over Germany. For them there is always a period of some relaxation, sometimes before reaching the Dutch Coast or after leaving the target, but there is most certainly one period after leaving the enemy coast and I think in most aircraft the anticlimax of relief starts then when the crew can start talking

amongst themselves, comparing notes of what they saw and what they thought about the whole trip. But in the case of the Mosquito there is little time for conversation. Both Pilot and Navigator are concentrating each on their respective tasks from take off to return. The Navigator has very little space and the pilot also has little. There is no question of moving even one's legs, quite apart from getting up and walking about the aircraft.

The aircraft is not too comfortable though it is well heated, and the cockpit layout is appalling. There is no relaxation, for after leaving the target the aircraft has to be navigated with very incomplete aids between the defended areas of Western Germany and there is to-day a steadily decreasing number of gaps in these defences. After this has been overcome there is the return from the enemy coast through the bad weather that invariably lies ahead, and it is only when the aircraft reaches its dispersal and stops its engines that the crew can, in any measure relax.

(iv) PHYSICAL FATIGUE

There is ample evidence to show now that the fatigue of flying fast, sensitive aircraft in bad weather conditions at high altitudes is infinitely greater than flying the heavier version with more stability, with more aids and with the Automatic Pilot. The mental strain of flying by instruments alone is considerable in Mosquitos, and it would appear that the effect merely of using oxygen of otherwise flying at oxygen heights introduces at least on third more increase in fatigue than in the parallel case of the heavy aircraft. There may be some medical explanation for this and I understand that the oxygen flow at 30,000 feet and above is insufficient in itself, and that a large increase in the amount taken has no further appreciable effect or that the blood is not able to absorb it. It may be that the fault lies in the fact that the volume of other gases is so small that their lack begins to show its effect. Closely bound up with this subject is that of the fit of the oxygen mask and the correct use of the equipment.

It has been observed that the longer trips appear to tire crews more, regardless of age or physical condition, and it may be possible to attribute to this the fact that the average crew prefers a short trip. It would seem to indicate that the psychological effect in a particular case of an attack on Berlin and its heavy defences, is of smaller import than the physical fatigue resulting from the long flight there and back.

In the ordinary case of the average aircrew in the rather low state of physical condition at which he maintains himself, the maximum reasonable number of long trips per week would appear to be two, which should be sandwiched between two short trips, making a maximum of four for one week. This though, could not be maintained continuously. On one occasion during a moon period, crews of this squadron were detailed to attack Berlin on ten successive nights, which they did, and owing to the crew strength at the time it was necessary to send one or two crews three nights in four. The effect on them was most marked, so much so that the medical authorities approached me to see whether the number of long trips could be reduced or more evenly spaced. This was not possible at the time.

I have found that a Pilot recently returned from leave is best fitted for a number of long trips in quick succession than one who is just about due for leave, and I have also noticed during the dark period that a number of short trips has a very much reduced physical effect than a smaller number of long ones.

In summing up the physical aspect one must take into consideration mental, and psychological, as well as physical factors as they all together go to make up the net result.

The difficulty of the aircraft in bad weather and the need for continual concentration on instrument flying, the fact that 90% of the Journey the aircraft is flying at oxygen heights and the mental strain of the thought of having to return into bad weather, combined with the acute discomfort of the aircraft, have cumulative effect on the navigator as well as on the Pilot.

An experiment was tried recently of flying for one hour at 41,000 feet after which it was found that the pilot was very tired and his passenger, not an operational aircrew, but another normally fit individual felt equally tired.

(v) FOOD, WARMTH AND REST

This point appears to me to be more a medical matter than executive, but it is only common sense that after flying over Germany at night with the attendant strain of so doing, the subconscious knowledge that there is a warm Mess, food and bed to return to is bound to have a large effect. Aerodrome conditions i.e. comfort and warmth, would thus appear to have a direct bearing on the morale of a squadron.

A squadron base on a well-established aerodrome in relatively comfortable conditions with hot food and tea immediately on return from operations, a warm Mess and comfortable quarters and a smoothly running well-established organization, can operate at a far greater intensity of effort than can the same squadron based on a satellite or having to work to any degree with improvised facilities or faulty organization.

Cold badly cooked and badly selected food has a very bad physical and psychological effect upon crews. If it is all they are offered as their pre-flight meal. It is apparent that little attempt in Bomber Command as a whole has been made either to discover what is that best type of meal for the different types of operation undertaken, or to standardize the quality and the type of meal throughout one particular Group. The result is that each individual station is left to its own resources, and on the station of which the writer has personal knowledge, the food invariably produced for the high flying Mosquito crews was not only ill-chosen but so bad that it was uneatable. Crews had to content themselves with soggy toast, jam and tea. This food actually was yesterday's roast beef re-served as a sort of fried meat slab. The potatoes were undoubtedly the lunch time potatoes fried in what tasted like goats fat. The monotonous appearance of the modern version of sausage was quite sickening. It may be argued that the allotment of 3 eggs per week solves the problem, but it does not. If the matter of when to eat the egg remains voluntary the average aircrew is not likely to waste it prior to a flight over enemy territory when his mind is quite likely occupied by other thoughts, but prefers to have his egg at breakfast time when he can derive the maximum enjoyment from it. The pre-flight meal should be conditioned by the nature of the operation to be undertaken. It should also be compulsory and should be selected by the Medical authorities, not the Catering Officer and the quality thereof should be in keeping with the tasks the individuals are expected to undertake. The operations of different Groups and commands in the Royal Air Force are different but it is pointed out that His Majesty's Royal Navy, whilst at sea has maintained pre-war standards of quality, quantity and Cooking and it is thought that an organisation such as the Royal Air Force could make a little better attempt than is evident at present.

(vi) <u>PHYSICAL FITNESS</u>

It must by now be axiomatic that physical fitness means efficiency in war, and though this may be realized by the higher authorities, it is by no means so with the average aircrew. The average aircrew in a Heavy Squadron that I have observed, and, to a lesser degree, those in this Mosquito Squadron, pay no attention to physical fitness, and their ideas of relaxation on a stand-down or a period of make and mend, are directed along the well trodden paths of beer, late nights and women. If they could be made to realize that when reduced to hard terms their lives depend upon physical fitness in so far as their mental reactions their physical skill and resistance to fatigue are concerned, it might then be that a reasonable percentage would do something about it.

I fear though that the average would be entirely unresponsive owing to their low mentalities and owing to the unfortunate fact that they have been given the impression from the very start theirs is merely to fly.

The cult of physical fitness can naturally be taken to extremes, though there is no doubt that a Pilot 100% fit is probably 60% more efficient than one who is not. How this is to be achieved is the problem. To indulge in regular physical training early in the morning before breakfast, is one solution, but unfortunately, to benefit from this the subject must be fit in the first place, which in most cases he is not. In the unfit subject it would probably take three weeks or a month before he reaches the stage where he can benefit from early morning physical training. Until then the effort of getting up early and taking exercise would probably only result in progressive fatigue during the day.

It is obviously undesirable for crews who have operated to be pulled out of bed the following morning to do P.T., and one authority has even questioned the value of physical Training at all during the slack period, on the grounds that sleep is more important. Unfortunately the Squadron Commander can compel Physical Training but he cannot compel his crews to go to bed at a reasonable hour. That sleep is important there is no doubt, but in the writer’s opinion physical Training is almost equally important, though not quite. If in the pre-Operational period, in all stages of the O.T.U. phase, a very rigid and vigorous system of physical getting fit aircrew and they, when they arrive could probably be kept fit enough by the operation of a modified system of Physical Training, which would probably be necessitated in any case by the demands of operations. These latter

requirements to those in force in peace time, when all ranks were compelled to take part in some organized game every Wednesday afternoon.

The next, and probably the more simple method is that of fresh air, and provided that aircrew can be made to stay in the open air for at least two hours a day either walking or running, they should be fit enough to meet the demands of the Bomber Command war as it is at present. How they would fare overseas is another matter.

(vii) MOSQUITO (MK IV and MK IX) LOSSES. SEPTEMBER, 1943 – FEBRUARY, 1944.

During the last six months the Mosquitoes of 139 squadron have operated, in most cases alone, against the most heavily defended targets in Germany. During the first two months of this period the losses were in the region of 3%, during the third month this was reduced to 1% and during the past three months there has been only one loss which I think can be ignored for the purpose of this paper. (The aircraft (Mark IX) on this occasion was plotted crossing the French coast at 30,000 feet going out. Shortly afterwards it went on to Broad Band I.F.F. and turned for home and then the plot quickly disappeared).

On my first arrival I found that the cruising speeds used for the Flight Plan were comparatively low for the type of aircraft (145 – 155 I.A.S.) and it appeared to me that the engines were being wrongly used. The climb to height was always made economically over base and the R.P.M. whenever possible, were reduced to the minimum in the found belief that thus petrol was being saved.

This state of affairs therefore must be considered in relation to the losses during the period. There has been from the start some attempt by the enemy at controlled and free lance interception of these Mosquitos when they were operating alone, but even though there were only two known successful ones, one in a searchlight cone and one over Bremen, to-day when the Mark IX’s and XVI’s are appearing more frequently, and at a somewhat higher speed, the enemy is still attempting to intercept. It may be that six months ago his aircraft were just capable of intercepting and had the necessary speed margin over our then low cruising speeds (from 145 knots, ultimately to 185 K.p.h. on the outward journey and 210 K.p.h. on the return). It may be that the losses have been reduced because these increased speeds have

almost ruled out for the present, the possibility of successful interception. On the other hand the fall in losses may be due to the fact that the inexpert 2 Group crews were posted from the Squadron and the more experienced ex "heavy" pilots and navigators introduced, but it seems to me that the single cause, if there can be such a thing, of the success of 139 Squadron Mosquitos, in the later stages, was their high speed and the skill and wisdom with which they were flown.

There is good evidence now and there has always been that the enemy is trying to intercept these Mosquitos, and up to the date of their last operation i.e. 9th February, 1944, he has continued to make quite determined efforts, obviously not for propaganda or for publicity purposes but for the material value of bringing the aircraft down. Bearing in mind then the probable cause of light casualties one has to consider now the fact that by addition of more weight and more appliances the unfortunate Mosquito is being made slower. In the first place this aircraft started its career as a high performance light bomber carrying a crew of two with four 250 lb. bombs, a radio set and nothing else. To-day the same aircraft is carrying four 500 lb. bombs and in a very short time the 4000 lb. bomb, "G" and "GH" Standard Blind Approach equipment, V.H.F. Radio Telephony, a D/R Compass and in some cases H2S, and from the initial weight of 16,800 lbs., at which the aircraft was first intended to operate it is now flying or will shortly be flying at 25,500 lb. This overloading tendency is common throughout the history of the Air Force, and is merely that well known British habit of taking a first class aeroplane, and spoiling it by additional weight instead of designing the aircraft around the job it is intended to do.

If there is any intention to operate Mosquitos, as in 139 Squadron, or to use them in large numbers and if, for one moment, this is being considered because their losses over the last six months have been negligible, then I would point out in the strongest possible terms that this is not likely to be so in the future. The simple reason being that by the addition of weight, the only means of defence of this aircraft has effectively been removed.

SUMMARY

The type of warfare now being conducted by Bomber Command is new. There are no precedents and it has not been done before, so of necessity every different measure is original. The fact of men fighting in what is virtually the front line, yet returning after each phase to almost normal life, warmth and rest, is somewhat unique. Each phase, it is thought, demands much more skill and resistance to fatigue and also determination, if it is to be done properly, than the similar case on land or on the sea. To relax in the air is to fail, to relax on the ground or on the sea is less important.

There is no doubt that the casualty rate in Bomber Command at present is extremely high, and that Air Force is at present paying the piper. To whatever influence this is owed, whether it be to the fact that bombing is still a political experiment, it remains that a very intensive form of active service is now being undertaken by Bomber Command aircrew. It is only really in its infancy and for the last four years much of it has been a matter of primitive improvisation. If we are to benefit at all from these four years then we ought to start calling now upon the experience of those who have taken part, not only in the air, but in the ground organisations, to see if some very rough skeleton of standard treatment and procedure in bomber operations can be laid down. Care must obviously be taken not to fall into the traps of Singapore and the Greek Islands and care must be taken to avoid the mistakes of the Army Command in the earlier years of the war, by not trying to standardise too much. The main object would appear to me to be to perfect the instrument but not to try to standardise its method of use.

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NOTE ON THE EMPLOYMENT OF MOSQUITO AIRCRAFT IN THE STRATEGIC BOMBER OFFENSIVE

1. It has been suggested on a number of occasions that there would be considerable advantages in the employment of a strong force of Mosquito (4,000 lb.) bomber aircraft in the strategic bomber offensive in place of, or in addition to, the heavy bombers. The purpose of this Paper is to discuss

the present employment of Mosquito aircraft and examine the possibility of forming an effective night strategic bomber force of Mosquito aircraft within Bomber Command to work either independently or in conjunction with the main force.

General Employment of Mosquito Aircraft

2. The production of the Mosquito aircraft until recently has been on a limited scale, and being an aircraft of unique operational qualities, it has been in great demand by all the Commands, with the result that, while the demands of every Command have been satisfied to a limited degree, the numbers of Mosquitoes in any one Command have been too small to be really effective. Even within the Commands themselves the aircraft have been retrospectively modified for several different uses, with the result that there are now some twenty marks of Mosquito aircraft, which seriously affects the rapid production of any one type. At Appendix 'A' [not reproduced here] is set out the present distribution of Mosquito squadrons in the Metropolitan Air Force.

Advantages of the Mosquito as a night bomber compared with the Heavy types

3. Weight-for-weight of bombs dropped, the small losses at present being incurred by Mosquito bombers give them an outstanding advantage over the heavy bomber. During the six months November 1943 to April 1944, Mosquitoes dropped 203 tons of bombs per aircraft missing against targets in Germany. Over the same period the figure for the heavy bomber was 70 tons. (These figures are conservative as on many occasions the Mosquito was employed in a marking capacity). From these figures it will be seen that the comparison of aircrew missing per tons dropped is as follows:-

(i) Mosquito – 101 tons per aircrew member missing.

(ii) Heavy Bomber – 10 tons per aircrew member missing.

4. Maintenance problems for the Mosquito are generally much simpler than those for the heavy bomber, and operational sorties are also of shorter duration. The result is that an average Mosquito bomber squadron completes over twice as many sorties per month as an average Heavy

Bomber squadron, (Mosquito squadron 225 sorties per month; Heavy Bomber squadron 108 sorties per month). Therefore, although the Mosquito normally only carries 1/3rd of the bomb load of the Lancaster, it would in fact drop 2/3rd the load in an average month. In the case of the Halifax the comparison is even more favourable.

5. The Mosquito has considerable tactical advantages over the Heavy Bomber. Its additional speed would allow greater penetration into Germany at night during the summer months. Its speed would probably permit it to be used on special occasions for low-level attacks by day or on important moonlight operations. Its manoeuvrability and size would permit vital targets to be attacked with relative safety from a lower level than in the case of the Heavy Bomber. These factors are likely to increase the morale of crews, which in turn, would result in a general improvement in bombing efficiency.

6. The Mosquito, fitted with Mk.XIV or T.1 bomb-sight, although a smaller aircraft, should prove under practical conditions to be as good a bombing platform as the Heavy Bomber. Operational trials should be done to confirm this.

7. Although the Mosquito is a small aircraft, little difficulty has been experienced in installing in it a variety of radio aids and extra equipment without detriment to its performance.

Its Disadvantages

8. The Mosquito is not at present capable of carrying a useful load of incendiary bombs. It is unsuitable as an area attack bomber as the individual loads are unlikely to produce on the ground the minimum incendiary density required. Up to 70% of the damage in area attacks is caused by fire, and the attack of cities by H.E. alone would normally be unprofitable. At present it can carry two 500 lb. Clusters in the bomb bays on the two front stations, each containing 106 × 4 lb. incendiaries, giving a total incendiary load of 848 lbs. By carrying two streamlined 500lb. clusters externally the incendiary capacity could be increased to 1696 lbs. but these streamline clusters are not yet available; as an alternative it would be possible to carry 4 × 350 lb. clusters (72 bombs in each) when these are developed.

9. It is possible that if the Mosquito were employed in greater numbers, the Germans would take more active counter-measures than at present and that the Mosquito would be found to be more vulnerable to night fighters than present experience suggests. (This is confirmed by recent reports that our Mosquito aircraft are meeting increasingly efficient enemy fighter opposition. The introduction of enemy rocket or 'jet' assisted night fighters will tend to increase the losses).

Present Employment of Mosquito aircraft in Bomber Command

10. The night bomber Mosquito forces of Bomber Command are at present employed in the following roles:-

(i) Nuisance and Spoof Raids. Bomber Mosquito aircraft of Bomber Command have, for a considerable time, been employed in small numbers in night nuisance and spoof raids. Recently, the numbers despatched to certain targets have been increased to 20/30, as larger numbers have been necessary to obtain the requisite German fighter re-action or to achieve a satisfactory "spoof" effect for the main force. The majority of attacks have been undertaken in poor weather conditions against targets lying in areas already heavily bombed. It has not been possible, therefore, to form any conclusion as to the degree of damage achieved in these raids. There has been one outstanding fact, i.e., the low percentage loss (under ½%) incurred by the attacking aircraft, and this fact alone indicates that careful consideration should be given to the employment of a greater number of Mosquito aircraft for strategic bombing attacks as against their employment for purely nuisance or spoof purposes.

(ii) P.F.F. Target Marking purposes. Mosquito aircraft used in a target marking role are becoming somewhat "scattered" throughout Bomber Command. This has been due to the introduction of a new and successful technique for visual identification and marking of targets from a low level. Broadly the target marking methods at present used are:-

(a) "OBOE marking (ground or sky).

(b) Low level visual marking (with illumination).

The two “OBOE” squadrons in the P.F.F. are entirely responsible and are adequate for all “OBOE” marking requirements; however, Mosquito squadrons for the low-level marking role are now being allotted to Groups. This policy of dispersion is fully justified at the present time for the attack of tactical targets, but may prove to be uneconomical when we revert to strategic bombing, as it has the disadvantages of duplication of specialist crews, aircraft and equipment which will not be fully employed.

Future Employment

11. In addition to fulfilling nuisance and spoof raid requirements, a night bomber Mosquito force of sufficient strength could be most usefully employed in:-

(i) The attack of important industrial complexes or small towns.

(ii) Low-level night mining operations.

Attack of Important Industrial Complexes or Small Towns

12. As a result of the great devastation that has been effected in German cities, particularly in the West, the number of profitable area targets available for attack by Bomber Command during the summer months has been greatly reduced. There remain, however, a large number of important industrial objectives which have so far escaped damage. The attack of such objectives by a moderate force of 200/300 Mosquitoes could cause serious damage to the enemy. Such attacks could be carried out in conjunction with the main force to fit in with nuisance or spoof raid requirements.

13. The ability of the Mosquito penetrate, during limited hours of darkness, to objectives out of reach of the main force of Bomber Command, would be a most useful asset.

14. These attacks would be on a scale large enough to cause effective damage and would, of necessity, force the Germans to take active counter-measures. The attacks, when carried out in conjunction with main force operations, would act as an excellent diversion and it is likely that the enemy night fighter organisation would be seriously embarassed by the two forms of attack and that an over-all reduction in losses of Bomber Command would be effected.

15. Generally, target complexes of small size normally unsuitable for attack by the main force, could be effectively attacked by an adequate force of Mosquitoes and this could be done at a far smaller loss.

Low-Level Night mining operations

16. The Mosquito is the only aircraft suitable for, and has already shown itself capable of, effective night mining operations against inland waterways. A new mine, the A Type H (Mark VIII) Mine has been specially developed for the mining of inland waterways and is now becoming available. The successful mining of inland waterways would have serious repercussions upon the German war effort.

Formation of an “all-Mosquito” Pathfinder Force

17. With the introduction of the long burning marker bombs, which burn for periods of up to one hour as opposed to the normal short burning markers, it is questionable whether the need for the Heavy Bomber in the P.F.F. for “backing-up” duties will continue. In any case this requirement must be considerably reduced and it is suggested that it could best be met by Mosquito aircraft.

18. The Mosquito can now be fitted with H2S Mark II or Gee-H which will permit it to undertake bombing or marking duties over cloud outside “OBOE” range. It is suggested that the Mosquito could, therefore, undertake all the duties of the Heavy Bombers now employed in the P.F.F. These bombers could, therefore, be replaced by Mosquitoes and returned to their normal bombing role.

19. The flare carrying capacity of the Mosquito is poor but could be improved if the Mosquito was to be employed on flare-dropping duties.

20. It is considered that if an “all-Mosquito” Pathfinder Force were formed in place of the present mixed force of Mosquitoes, Lancasters and Halifaxes, a more homogeneous and therefore more effective force, would be possible. Due to the light losses incurred by the Mosquitoes the saving of the highly specialised P.F.F. aircrew will be very considerable, and this in turn will result in raising the standard of marking generally.

Role of Mosquito Aircraft in the Far East

21. Although no provision has yet been made for the employment of Mosquito bombers in the Japanese war, it is considered that such a force could usefully be employed. A force of 200/300 Mosquito aircraft might well prove a valuable supplement to the Heavy Bomber operations.

22. In certain areas where logistic problems are likely to arise and limited airfield facilities preclude the operation of the Heavy Bomber, a Mosquito Night Bomber Force could be used to advantage. Such a force would be readily mobile and able to exploit the capture of new areas with the least possible delay.

23. Should a bomber force be based in the Russian Maritime provinces, Mosquitoes could usefully be employed, as they would be within range of targets in two-thirds of Japan. The enemy shipping routes and inland waterways in the Far East would provide useful opportunities for the use of Mosquitoes in sea-mining and the attack of shipping.

24. Trials have been completed in India to determine the suitability of the Mosquito for operation in tropical climates. It has been found that only minor modifications to the aircraft are necessary and that the tropical Mosquito VI is at present 12 miles an hour slower than the temperate version.

25. The American authorities have expressed the opinion that we should deploy as many Mosquito aircraft of all types as possible in the Far East War. Therefore, if we now form in this theatre a Strategic Force of night bomber Mosquitoes, they will be available for transfer to the Far East at the end of hostilities with Germany.

Production of Mosquito aircraft and future allocation

26. The production of the Mosquito aircraft as detailed in Appendix ‘B’ [not reproduced here] shows that of a total of 8,817 Mosquito aircraft produced by the end of 1945, only 1,582 (18%) are of bomber version, while 4,303 (50%) are fighter/bombers. Of the total bomber production only 602 are Mark XVI (4,000 lb.) bombers.

27. Canadian production (now approximately 50 a month) of the Mosquito to bomber is to cease during December 1944 and thereafter only

fighter/bomber Mark VI are to be produced. Australian production is limited to fighter/bombers only.

28. The single engined fighter/bomber, which can carry up to 2,000 lbs., has already proved an outstanding tactical weapon of this war and it is suggested that it is capable of fulfilling all the tasks now carried out by the Mosquito fighter/bomber by day at smaller loss. It is questionable, therefore, whether the allocation of such a large proportion of Mosquitos to fighter/bomber production as against other uses for this aircraft, is necessary.

29. O.R.S. Report No. 274 states that "the most striking feature of the summary of P.R.U. activity covering September to December, 1943, is the consistently greater enemy opposition to Mosquitoes than to Spitfires. The Mosquito is not able to operate at such great heights as the Spitfire, with the consequence that when the contrail belt is so low that it is unsafe to fly below it the Mosquito may be unable to climb above it while the Spitfire can." It is becoming increasingly obvious that the value of the Mosquito as a P.R.U. aircraft is becoming limited. It is, therefore, suggested that some of the future P.R. Mosquito production could well be changed over to bomber production.

Conclusions

30. (i) Owing to its low casualty rate, the Mosquito bomber is, ton for ton dropped, nearly three times as economical in aircraft as the Heavy Bomber and ten times as economical in aircrew personnel.

(ii) A force of Mosquitoes would be unsuitable in itself for purely area attack but it would be particularly suitable for the attack of semi-precise industrial objectives.

(iii) The Mosquito should be capable of performing all P.F.F. functions more efficiently than the Heavy Bomber; an "All-Mosquito" P.F.F. is likely to be more effective and much more economical than the present mixed force.

(iv) A Mosquito Bomber Force would be most useful and effective in the Far East.

(v) The operational roles for the Mosquito night bomber as outlined in para. 10(ii) of this Paper confirms the great importance of

increasing the Mosquito force within Bomber Command. If authority was given for the re-allocation to bombers of some of the future Mosquito production it would be possible to form an "all-Mosquito" Group to include a Strategic Night Bomber Force and a Mosquito Pathfinder Force.

Recommendations

31. (i) That an immediate investigation be made on a high level into the desirability of the formation of a Mosquito Strategic Night Bomber Force within Bomber Command and the formation of an "All-Mosquito" Pathfinder Force. Such a force should be operated within one Group and under one control.

(ii) That a review of the present plans for the production and allocation of Mosquito aircraft be undertaken with a view to investigating the possibility of re-allocating Mosquito production to permit of the formation of the "All-Mosquito" Group referred to in (i) above.

(iii) That an investigation be made into the possibility of improving the flexibility of bomb load of the 4,000 lb. Mosquito with a view particularly to improving its present ability to carry incendiary, flare, and marker loads.

B.Ops.1.
13th June, 1944.

MEMORANDUM ON MOSQUITO AIRCRAFT FOR PATHFINDING.

1. The requirements of a Mosquito for pathfinding in the "Tiger" Force are to some extent incompatible. No aircraft is completely suitable but the two that approach nearest are the Canadian-built B.25 with 2 Packard Merlin 225's rated at 14,000 feet and the British B.35 with 2 Merlin 113/114's rated at 30,000 feet and with a pressurised cabin. Below is a comparison of these two aircraft on points relevant to their use in the "Tiger" Force.

Range.

2. No. 5 Group marking technique requires a descent to ground level in the target area, and 20 minutes over the target. The Mosquito 25 can operate under these conditions with a 15% safety margin over a range of 1490 nautical miles. With large bomb doors this range is reduced to 1390 nautical miles. The B.35 can operate under similar conditions over a range of 1326 nautical miles.

Performance.

3. The Mosquito 25 has a cruising speed of 230 knots at its most economical height of 15,000 feet and a maximum speed at ground level of 303 knots. The Mosquito 35 cruises at 310 knots at 30,000 feet. Details of maximum speed at ground level are not available but it is estimated at 290 knots.

Bomb Doors.

4. The B.25 is normally fitted with small bomb doors but is obtainable with large doors, though it cannot carry the 4,000 lb. bomb. The B.35 is only fitted with large doors. The effect of large doors on performance is negligible but tankage is decreased by 36 gallons. A successful T.1 has been recently held of an adapter to allow 2 × 1,000 lb. target indicators to be carried on the B.25 with small bomb doors. This adapter could probably be made available in sufficient quantities by August if pressure is brought to bear.

H. 2. S. Mark.VI.

5. H.2.S. MK.VI cannot be fitted in the ventral position in either of these aircraft. The only aircraft that can take it are the B.IX and the earlier B.XVI's, both of which are out of production. However, the effect of Mark VI H.2.S in the ventral position is to reduce speed by 10 knots and range by about 80 nautical miles. Priority work to fit H.2.S Mark VI in the nose is in hand and there is every prospect of success. This would be available in the B.25 or the B.35.

Navigational Equipment.

6. Loran, Gee and VHF can be carried in all aircraft. The Bomb Sighting Head can be fitted with the windfinding attachment in both types if H.2.S is not carried, in neither if it is carried.

Maintenance.

7. The B.25 is a well tried aircraft and the Merlin 225 is well known. It has not been tropicalised and D.O.R is not prepared to state that it can be cleared for our climate without tropicalisation. It can be tropicalised but at considerable cost in man-hours.

The B.35 is completely untried and the Merlin 113/114 engines are an unknown quantity. They will however be fully tropicalised.

Neither of these aircraft are in use in the Far East so that no spares are available for either. However the P.R.34, with which the P.R./Met Squadron will be equipped, is a very similar aircraft to the B.35 and both the P.R. 34 and the B.35 will later be introduced into A.C.S.E.A.

Summary.

8. The major difference between the two types of aircraft are therefore as follows:-

(a) The B.25 has a better range and can attack two more industrial centres than the B.35.

(b) The B.35 has large bomb doors. The B.25 can however carry 2 1000 lb. target indicators.

(c) The B.25 is a tried aircraft with tried engines. The engines in the B.35 are an unknown quantity.

(d) Use of the B.35 would simplify supply owing to its similarity to the P.R.34.

(e) The B.35 is tropicalised. Tropicalisation of the B.25 will require some 1400 man hours.

9. Little is known of the performance of H2S Mk. VI owing to restrictions on its use, but in the few operations on which it has been used it was shown that low level precision blind marking was practicable. Japanese use of smoke screens is a strong argument in its favour. A nose installation would

have little effect on performance but would prevent wind-finding. However No. 5 Group recommend that marking aircraft should not be used for wind-finding.

10. It is recommended that the pathfinder squadron be equipped with Mosquitos B.25s, tropicalised and fitted with adaptors to carry 1000 lb. target indicators in small bomb doors. 14 of these aircraft should have H2S Mk. VI with nose scanner, the remaining 6 to carry sighting heads with wind-finding attachments and to be used solely for wind-finding.

[Signed A D Trewicki]
Group Captain.

15th May, 1945. A.S.P.

Factors to be considered.

(1) Safe Range at best heights.
(2) Bomb load (a) Normal bomb doors.
(b) Large bomb doors.
(3) Availability of aircraft.
(4) Previous experience of type in tropics.
(5) Availability of spares in Far East.
(6) Equipment which can be carried:
e.g. (a) Windfinding attachment with Bomb Sighting Head (Computor Box etc. not required).
(b) Loran and Gee.
(c) Two sets of V.H.F. etc.
(7) Can H2S mark VI. be fitted ? Has it been fitted already? If not, how long before it will be cleared.?
(8) Advantages and disadvantages of:-
(a) Nose scanner.
(b) Ventral scanner.
(9) What are the outstanding points up to date about H2S Mark VI experience?
(10) Which types of Mosquito are tropicalised? Is tropicalisation essential?

DRAFT. **TOP SECRET.**

Reference:
TIGER/TS.7/AIR.

Nucleus Planning Staff,
"TIGER" Force,
c/o Transport Command,
Bushy Park,
Teddington,
Middlesex.
18th May, 1945.

Sir,

MOSQUITO REQUIREMENTS "TIGER" FORCE PATHFINDING SQUADRON

I have the honour to refer to this Headquarters letter, VLR/TS.7/AIR of the 27th April, 1945, and to state that as a result of a conference held on the 17th May, 1945 between A.C.A.S. (TR) and the Force Commander Designate, "Tiger" Force, it is now possible to give more exactly the requirements for Mosquito aircraft for the Pathfinder Squadron of the above Force.

2. Owing to the difficulty of tropicalising the Mosquito B.25, and since it will not be possible in the time available to install H2S Mk. VI in the nose of a Mosquito, the Mosquito B.35 with a ventral H2S Mk. VI installation must be accepted for low level blind marking. It is essential that this aircraft be fitted with small bomb doors and with the full fuselage petrol tankage of 536 gallons as opposed to the 500 gallons with aircraft with large bomb doors. This aircraft should also be fitted with Gee, Loran, two 4-channel V.H.F. sets, A.P.I. and if possible an adaptor to allow two 1,000 lb. target indicators to be carried.

3. Since the B.35 with a ventral H2S installation will have a very limited rang there must also be available a Mosquito to carry out visual marking at greater ranges. For this a further 20 B.35s are required without H2S. It is not essential that these aircraft have small bomb doors, but they must have a full fuselage tankage of 536 gallons. If small bomb doors are fitted the adaptor for two 1,000 lb. target indicators must also be fitted. In addition this aircraft should be equipped with Gee, Loran, two 4-channel V.H.F. sets, A.P.I. with Wind Finding attachment and Mk. XIV sighting head.

4. It is, therefore, requested that the Mosquito Pathfinder Squadron of the "Tiger" Force be established with 30 U.E. Mosquito B. 35s. modified in accordance with the above requirements.

DRAFT. **TOP SECRET.**

Reference:
TIGER/TS.7/AIR.

Nucleus Planning Staff,
"TIGER" Force,
c/o Transport Command,
Bushy Park, Teddington,
Middlesex.
18th May, 1945.

Sir,

MOSQUITO AIRCRAFT FOR "TIGER" FORCE.

Investigations have been carried out recently by this Headquarters into the possibility of using Mosquitos fitted with Mk. VI H2S for marking targets for the "Tiger" Force. Greatest importance is attached to this development owing to the possibility of a drastic reduction in the number of heavy pathfinder aircraft required for dropping planes etc with a consequent increase in the weight of bombs dropped.

2. It has proved impossible in the limited time available to instal a nose scanner for H2S Mk. VI in a Mosquito. It is also impossible to tropicalise the Mosquito B.25. The best alternative remaining is the Mosquito B.35 with small bomb doors and a ventral scanner. This is a satisfactory aircraft from the marking point of view but will have a limited range. It has therefore been decided that aircraft without H2S must also be supplied for visual marking on targets at a greater distance.

3. Air Ministry have, therefore, been asked to equip the Mosquito Pathfinder Squadron as follows:-

(a) One flight of 10 B. 35s. fitted with H2S Mk. VI, Gee, Loran, A.P.I. and two 4-channel V.H.F. sets. These aircraft are to be fitted with small bomb doors and an adaptor to allow the carriage of two 1,000 lb. target indicators.

(b) Two flight of 10 B.35s. each fitted with Gee, Loran A.P.I. with Wind Finding attachments Mk. XIV sighting head and two 4-

channel V.H.F. sets. These aircraft are to be fitted either with small bomb doors and a twin adaptor for the two 1,000 lb. target indicators or with large bomb doors but with the fuselage tanks as normally fitted with small bomb doors.

H.Q. Bomber Command.
Copy to:-
No. 5 Group.

I have the honour to be,
Sir,
Your obedient Servant.
Air Marshal, Hugh Pughe Lloyd
Commander Designate, "TIGER" Force.

AIR MINISTRY LONDON, S.W.I.
19th May, 1945.

TOP SECRET

CMS.729

"TIGER" FORCE

MOSQUITO AIRCRAFT REQUIREMENTS

Sir,

I am directed to refer to the meeting which took place in Room W.72/II, Air Ministry, Whitehall, on the 17th May, 1945, and the telephone conversation on the 19th May between Air Vice-Marshal Slattery and Group Captain Odbert, and to forward herewith the information you require in respect of the Mosquito B.XXXV.

2. The performance is based on a Mosquito B.XXXV fitted with Merlin 113/114 engines, normal bomb doors in place of the 4,000-lb. bomb doors, and having provision for the following:-

(a) Marking

(i) Radio equipment: H2S Mk.VI (in ventral position), Loran, Gee, A.P.I., and two 4-channel V.H.F. sets.

(ii) Bombs: two 1,000-lb. target indicators.

(iii) Tropicalisation: suitable for operating in temperatures up to 90°F.

(b) Wind Finding

(i) Radio equipment: Loran, Gee, A.P.I., with wind finding attachment, Mk.XIV sighting head, and two 4-channel V.H.F. sets.

(ii) Bombs: two 1,000-lb. target indicators.

(iii) Tropicalisation: suitable for operating in temperatures up to 90°F.

3. The ranges quoted in each of the following cases are still air ranges achieved after making allowance for –

(a) Take off and climb to 15,000 ft.

(b) Economical cruising at 15,000 ft.

(c) Descent and 20 minute maximum cruising at 5,000 ft. over the target.

(d) Climb to 15,000 ft. (in home direction only).

(e) Return at economical cruising at 15,000 ft.

(f) 40 minutes reserve at cruising speed for minimum gallons per hour over home base.

(A) Marking

Maximum all-up weight ..... 25,500 lbs.
Maximum allowable fuel ..... 846 gallons.
Still Air Range ..... 1,700 nautical miles.
Excess over range required ..... 13.2 %.

Safety reserve in this case is 20% as opposed to our normal 33.1/3%.

(B) Wind Finding

(i) Maximum all-up weight ..... 25,125 lbs.
Maximum allowable fuel ..... 846 gallons.
Still Air Range ..... 1,770 nautical miles.
Excess over range required 18%

The safety reserve in this case is 20% as opposed to our normal 33.1/3%.

(ii) Maximum all-up weight (overload) 25,519 lbs.
Maximum allowable fuel ..... 900 gallons.
Still Air Range ..... 1,900 nautical miles.
Excess over range required 26%

The safety reserve in this case is up to our normal standard.

Work Involved

The work involved in case (A) above is estimated at 300 man hours per aircraft and 100 man hours per aircraft in the cases of (B) (i) and (ii).

It is not possible in the time available to state definitely that the assembly of radio equipment can be accommodated, but no serious difficulties can be foreseen at present. A trial installation of the two assemblies will be required.

In case (B) (ii) above, the weight has been made up in fuel in lieu of H.2.S. Mark VI, which is not required in the Wind Finding Aircraft.

The undercarriage factor at 25,200 lbs. is 4; at 25,500 lbs. the undercarriage factor approximates to 3.2. Therefore, at 25,500 lbs. all-up weight, the take offs must be carefully executed from good concrete runways.

I am, Sir,
Your obedient Servant,
[Signed, NC Odbert for]

Air Commodore,
Director of Operational Requirements.

10 April 1944: a Royal Air Force Mosquito bomber being loaded with a 4000lb bomb.

RESTRICTED. 3rd Part of Report No. A.&A.E.E./767.P

AIRCRAFT AND ARMAMENT EXPERIMENTAL ESTABLISHMENT

BOSCOMBE DOWN.

SEA MOSQUITO TR 33 LR.387

(TWO MERLIN 25'S)

BRIEF HANDLING TRIALS

A.&A.E.E. ref:	5711, h/53/CSW
M.A.P. ref:	SB. 61581/11/RDN3, b
Period of tests:	June – November, 1945.

Progress of Issue of Report.

Report No.	Title
1st Part of A.&A.E.E./767p	LR.387 – Cockpit layout.
2nd do.	LR.387 – Weights and loading data.

Summary.

Brief handling trials, including tests when carrying certain external stores, were made on the first prototype Sea Mosquito TR Mk.33 LR.387.

Tests were made with the normal (6.9%) and increased (9.75%) elevator horn balance and these showed that the increase in area of the horn effected a marked improvement in the longitudinal control characteristics. The aircraft is recommended as acceptable for Service use for loadings giving a c.g. position up to 16.0 ins. aft of datum, undercarriage down, (34.3% SMC,

undercarriage up) although it would be acceptable as an emergency measure with the c.g. at 16.9 ins. aft, undercarriage down, provided the pilots were warned of the low stick forces encountered in the dive, and of the tendency to tighten up in the dive recovery.

1. Introduction.

Deck landing trials were made on this particular aircraft in April, 1944, when classified as a Mosquito Mk.VI, but equipped with four bladed propellers and deck arrestor gear.

Following subsequent alterations, including the provision of folding wings, LR.387 became the first prototype Sea Mosquito TR Mk.33.

Brief handling tests were commenced at this Establishment in July, 1945, to provide information on the type both as flown in the "clean" condition and when carrying externally fitted stores.

The preliminary tests with the aircraft in the condition referred to later as "Stage 1", with the normal 6.9% elevator horn balance fitted were stopped because of the unexpectedly poor handling qualities found, and the aircraft was returned to the contractor for investigation on 5th September, 1945. Further testing was resumed at A.&A.E.E. in October, 1945, the aircraft then being modified with the increased elevator horn balance, and in the condition referred to later as Stage 2.

Preliminary results were sent to M.A.P. (R.D.N.2.d.) by letters dated 23rd August and 5th November, 1945.

2. Condition of Aircraft Relevant to Tests.

2.1 General. (See attached photographs). Externally the aircraft was a normal Mosquito FB Mk.VI except for the following features:-

2.11 Fuselage.

(a) An A.S.V. blister and a V.H.F. rod aerial fitted in the nose. This necessitated the removal of the 4 × .303" guns, but the four 20 mm. guns fitted with sealed muzzles and open ejection tubes were retained.

(b) Torpedo crutches and strop (with bungee retainer) fitted beneath the closed bomb-doors.

(c) An arrester hook attached to the under surface of the rear fuselage forward of the tail wheel.

2.12 Wings. The wings were modified to allow the outboard wing sections (i.e., the sections outboard of the wing flaps) to be

folded upwards. The hinges projected about one inch above the wing surface, but apart from this, the surface condition was good and up to the usual Mosquito standard.

2.13 Tail Assembly Details and changes Made During the Trials. The normal tailplane of 20' 9" span was fitted initially with a metal covered elevator having the 6.9% horn balance (referred to hereafter as stage 1), but later the aircraft was returned to the Firm where the elevator horn balance was increased to 9.75%. This modification, together with an aileron adjustment and the fitting of a Lockheed oleo pneumatic undercarriage. Brought the aircraft to a condition referred to hereafter as stage 2. The standard 9 ¾ lb. inertia weight (20 lb.ft. moment) was fitted in the elevator circuit just forward of the fuselage access door.

The incidence of the tailplane to the aircraft datum line (taken at the inboard rigging position) was 6° 48' at the outset, and was found to be 0° 44' on conclusion of the trials.

The elevator trimmer range was from 3 divisions aft to 3 ¾ divisions forward. These movements corresponded to trimmer angles of +4° 50' and – 9° 45' respectively. (These angles are those relative to the elevator chord line with the elevator in its neutral positions.)

2.2 Airframe Limitations The maximum permissible airspeeds were:-

In dives	347 knots
In dives carrying Mk.VI and MK.VIII mines	304 knots

Due to the wing strength being less than standard on this aircraft because of the folding modification, the normal accelerations were limited to a maximum of 4.4g at a weight of 20,500 lb.

Extracts from the Form 1125 giving a list of the modification numbers embodied on this aircraft is given in Appendix I [not included here].

2.3 Engine Installation. Two Merlin 25 engines were fitted. Each had five exhaust stubs per cylinder bank, and ice-guards on the air intakes.

Engine Limitations.

Conditions	R.P.M.	Boost lb/sq.in.
Take-off and combat	3000	+18
Max. Climb and emergency cruise	2850	+ 9

Max. Cruise	2650	+7
Dive with throttle less than 1/3rd open	3000	–
Dive with throttle more than 1/3rd open	3150	+18

2.4 Propellers. Four-bladed De Havilland propellers (Type D.14/445/1) were fitted, instead of the three-bladed De Havilland Propellers normally used on Mosquito FB Mk. VI aircraft.

2.5 Airspeed System. The Pilot's airspeed indicator was connected to the Mk. VIII pressure head on the fin, and to the static vent on the starboard side of the nose. Although this static vent was in the normal position for a Mosquito VI, the position error was not known, since the shape of the fuselage nose ahead of the vent was modified by the inclusion of the A.S.V blister.

2.6 Loadings. The aircraft was tested under the following loading conditions:-

Ref. No.	Take-off weight lb.	C.G. Position				Condition (Stage 1 & stage 2 are fully explained in Para.2, 13)
		U/C down		U/C up		
		Ins. aft of datum	%SMC	Ins. aft of datum	%SMC	
1a	21,000	17.7	34.7	19.1	36	Stage 1
1b	20,770	17.1	34.1	18.5	35.5	No external stores
2a	20,650	16.9	33.9	18.1	35.2	No external stores
2b	22,170	16.3	33.3	17.5	34.4	Stage 2(2Mk. VIII mines under
2c	21,710	13.1	30.1	14.3	31.3	wings.)
2d	20,235	13.9	30.9	15.1	32.1	(One Mk. VI mine under fuselage.) (8 x 11 ½ lb. practice bombs under wings.)

There was a reduction in the moment change on raising the undercarriage in Stage 2 Compared with Stage 1 because of the lighter weight of the modified under-carriage.

The basic aft e.g limit given in the Form 1187 for this aircraft was 17.78 ins. aft of the datum (undercarriage down) at a weight of 21,063 lb.

2.7 Test Equipment. A Kollsman accelerometer was fitted and a hand held spring balance type of stick force indicator was used (range 0–50 lb.).

2.8 Static Friction in the Controls. The frictional forces in each circuit were measured on the ground by means of a spring balance attached to each control. The following figures are a mean of a

number of readings and represent the values obtained with the control in steady motion from the central position:-

Elevator: 7 ½ lb. (5.7 lb.)
Ailerons: 7 lb. (3.7 lb.)
Rudder: 7 ½ lb. (7.1 lb.)

The corresponding values required by AP. 970, AL.23 are shown in brackets.

3. Scope of Tests.

Brief handling tests were made including take-off, climb, level flight, stalls, dives and asymmetric handling, with and without external stores fitted.

The external stores tested were selected a covering the worst aerodynamic features of a wide range of stores that may be carried on this aircraft. This range of stores was detailed in the appendix to a letter from R.D.N.3. dated 12.6.45 (reference 3B. 61581/11) and is reproduced as Appendix II [not included here] to this Report.

The preliminary tests made on the aircraft in its original condition (Stage 1) were repeated at modified loadings at Stage 2.

In the latter tests, special note was taken of the behaviour of the modified undercarriage during taxying, take-off and landing.

4. Results of Tests.

4.1 Aircraft as Tested in Stage 1 Condition. (See para. 2.6.) The following deals only with those phases of flight for which the results differ materially from those quoted later in para.4.2.

4.11 Longitudinal Behaviour.

4.111 Loading 1a (c.g. 17.7 ins. aft of datum. Undercarriage down). The longitudinal behaviour of the aircraft was bad, and it was not possible to fly the aircraft “hands off” except on the climb. Throughout the cruising range in level flight it was very difficult to trim the aircraft accurately, and it required undue concentration to maintain level flight particularly in disturbed air conditions.

The stick force in turns up to 3g (accelerometer reading) and 235 knots ASI was very light, but although this force varied during the turns, it never

reversed and there was no tendency to tighten up.

The longitudinal behaviour with flaps and undercarriage down was also bad and during a powered approach at 100 knots using +2 lb./sq.in. boost, a great deal of concentration was necessary to maintain a steady airspeed and flight path due to the changing stick forces.

The aircraft touched down at 87 knots ASI.

4.112 Longitudinal Behaviour at Loading lb. (e.g. 17.1 ins. aft of datum, undercarriage down). The longitudinal handling characteristics were substantially unchanged from the previous loading except that the stick forces in turns had improved.

At 9000 ft. using 2300 rpm, more boost at 192 knots ASI, it was impossible to trim the aircraft to fly hands off. In attempting to fly hands off with the elevator trimmer set at on division nose heavy the aircraft would either increase or decrease speed. In the former case the speed rose to 245 knots at which point the aircraft recovered sharply at 2.3g (accelerometer reading), and on decreasing speed the aircraft went up to the still.

The aircraft did not tighten up in turns, the stick forces recorded were:-

16 lb. to right and left in turns up to 2.5g (accelerometer reading) at 191 knots ASI. And

8 lb. to right, 9 lb. to left in turns up to 2.6g (accelerometer reading) at 234 knots ASI.

In the dive the forces increased progressively, but at speeds in excess of 304 knots ASI it was necessary to apply an immediate restraining force on releasing the control column.

In view of the adverse characteristics the aircraft was not dived to the limiting speed of 347 knots ASI.

In the engine-on approach, with flaps and undercarriage down at 100 knots ASI, the aircraft was longitudinally statically unstable, although not to the same degree as on the previous loading, but of sufficient degree to be characterized by an experienced naval pilot as most undesirable for deck landings.

4.12 Lateral Behaviour. During tests at the initial loading, (1a), the ailerons were found to overbalance following coarse aileron movements at low speeds. Immediately after a take-off at 78 knots ASI, when correcting a wing drop, the ailerons

overbalanced at approximately half travel. There was a fairly rapid snatch and although the force to overcome it was fairly light, it was most disconcerting.

During trials when airborne, it was found that the tendency to overbalance was most marked at 105 knots ASI and below.

Subsequent to these tests, investigation showed that the ailerons were incorrectly rigged, and it is suggested that the derangement of adjustment may have occurred when the wings were folded or unfolded in the interval between the firm's flight tests and these referred to above.

No aileron overbalance was experienced in subsequent tests with the corrected aileron rigging.

4.13 Summary of characteristics in Stage 1 condition. The aircraft was found to require undue concentration on the elevator control to maintain steady flight throughout the speed range. If not restrained by the pilots intervention, relatively high normal accelerations were quickly attained, in phugoids resulting from attempts at stick free cruising flight, or in recovery from out-of-trim dives.

These characteristics made the aircraft unpleasant to fly and were substantially unchanged by movement of the e.g. from 17.7 ins. 17.1 ins. aft of datum (undercarriage down).

In addition the preliminary tests disclosed that the ailerons were overbalancing with coarse movements at low speed but this was attributed to incorrect aileron rigging and subsequently rectified.

In view of the unsatisfactory longitudinal stability characteristics the aircraft was returned to the Firm where after preliminary flight tests the aircraft was modified to Stage 2 condition.

4.2 Aircraft as Tested in Stage 2 condition (sec para.2.6).

4.21 Undercarriage Behaviour (Loading 2a, b, c, d of para.2.6). Little difference was noticeable between the taxying characteristics of the oleo-pneumatic undercarriage compared with the normal rubber shock absorber type, but in take-off and, more noticeably, in landing the damping qualities to modified undercarriage were better. There was noticeably less tendency to "bucket" for instance, on hitting a ridge on the grass airfield.

4.22 Take-off and initial Climb. At all loadings tested the take-off was considered to be much easier than on a normal Mosquito VI, with less tendency to swing and comparable take-off powers, although the critical period before attaining safety speed in the event of an engine out is materially increased on this aircraft when using +18 lb/sq.in. boost for take-off.

4.221 At Loading 2(a). Using 15° of flap, 3000 rpm and +18 lb/sq.in. boost, elevator trimmer set 0.5 division nose heavy, the take-off was straightforward the aircraft becoming airborne at 80 knots ASI approximately. Retraction of the undercarriage produced a slight nose up change of trims, counteracted by the nose down change on retracting flaps as normal for Mosquito VI.

With the take-off conditions as specified and with the undercarriage retracted, failure of each engine in turn was simulated by rapidly throttling back.

The minimum speed at which full control (i.e. directionally as well as laterally) could be maintained was 168 and 165 knots ASI with the starboard or port engine out, respectively. Lateral control could however be maintained down to 147 knots ASI but with the aircraft skidding with the live engine. Using 3000 rpm, +12 lb/sq.in. boost, this minimum speed for full control was reduced by approximately 9 knots but the speed necessary to retain lateral control remained at 147 Knots ASI.

4.222 Loading 2(b), (c), (d). With the external stores fitted there was no noticeable difference in the actual take-off, but the following approximate times were noted for each loading for accelerating from the take-off speed to the minimum speed to retain lateral control in the vent of engine failure (147 knots ASI using +12 lb/sq.in. boost).

Take off speed ASI knots	Time to attain lateral control speed (147 knots ASI Seconds)	Loading Ref. Para. 2.6. Remarks
87	30	2b MK.VIII mines under wings
86	27	2c One MK. VI mine under fuselage
83	25	2d 8 × 11 ½ lb. practice bomb

under wings

4.23 Stability and control. At all loadings (2a, b, c, d of para. 2.6) the longitudinal stability and control characteristics had improved greatly with the modification and the aircraft was quite pleasant to fly.

The ailerons were light and effective throughout their speed range.

In general, the handling characteristics (with the enlarged horn balance) were normal for the standard Mosquito VI (with 6.9% horn balance and 3-blade propellers) at the same weight and e.g. position (see 2nd part of this Report), except for same deterioration in the longitudinal stability at low speeds as in the approach glide.

In turns the stick force remained positive at all times with no tendency to tighten up.

The following values were recorded at loading 2a with the c.g. 16.9 ins. aft of datum (undercarriage down).

Trimmed speed Knots ASI	Accelerometer reading in the turn 'g'	Stick force in turns to	
		Left lb.	Right lb.
252	2.6	18	18
231	2.5	18	17
187	2.4	24	24

4.24 Stalls. At all loadings (2a, b, c, d) the characteristics in the stall and recovery were normal as for a Mosquito VI.

At loading 2a (e.g. 16.9 ins. aft of datum, undercarriage down), with the flaps and undercarriage up, elevator trimmer at "zero" and in trim for 230 knots at maximum cruising power, a stick force of 13 lb. was required to decrease speed to 122 knots ASI.

This force fell off with further backward movement of the control column until at the stall, which occurred at 112 knots, it was 8 lb.

The elevator movement was large, the control column being nearly right back at the stall.

At the same loading, but with the flaps and undercarriage down, trimmed to glide at 122 knots ASI the stick force to stall the aircraft was very light (approximately 3 lb.) and the control column movement was small.

The ailerons were effective down to the stall at 95 knots ASI but although the force to deflect the ailerons fell to zero after half deflection there was no

overbalance as occurred in the previous tests before the ailerons were adjusted.

4.25 Dives.

4.251 Loading 2(a). With the aircraft trimmed for level flight at 12,500 ft. at 3000 rpm, +16 ½ lb/sq.in. boost in FS supercharger gear, Radiator shutter closed at 251 knots ASI (0.2 divisions nose heavy elevator trim) dives were made to the limiting value of 347 knots ASI.

The following observations were made in straight dives and recoveries to the speeds shown.

ASI knots	Stick force[M] in the dive lb.	Accelerometer reading 'g'	Force to initiate recovery lb.	Force to restrain recovery lb.	Remarks on recovery
287	2	2.4	8	–	Pull force reqd. fell to zero.
313	4	2.5		4	Restraint used 2–3 secs. after initiation to restrict 'g'
330	6	2.5		8	
347	6–8	2.8		10	Restraint used after 1–2 secs. as a/c tended to tighten up in recovery.

[M] The forces shown in the dive were obtained in accelerating flight; it was found that on stabilising in the dive at any speed above the trimmed speed, up to 305 knots ASI the stick force required fell to zero, giving the impression of longitudinal neutral static stability stick free.

Trimming in the dive required very small movements of the elevator trimmer. From a trimmed dive at 313 knots ASI a pull force of 10 lb. was used to initiate recovery, but had to be relieved almost immediately due to the acceleration building up, the maximum accelerometer reading reached being 2.8g.

4.252 Loading 2b (2 Mk. VIII mines under wings). Trimmed for level flight at 12,000 ft. at 3000 rpm, +16 ½ lb./sq. in. boost in FS supercharger gear, radiator shutters closed, at 251 knots ASI (0.1 division elevator trim), the aircraft was dived to the limiting speed (with the external stores) of 304 knots ASI.

The forward stick force to hold the aircraft in the dive was 10 lb. On release of the central column, the aircraft recovered rapidly, and after 2–3

seconds a restraining force of 18 lb. was necessary to restrict the acceleration to 2.5g.

The mines had no detrimental effect on the diving characteristics of the aircraft (see also para.4.4).

4.253 Loading 2c (One Mk.VI mine under fuselage). Trimmed for level flight at 12,000 ft. at 3000 rpm, +17 lb/sq. in. boost in FS supercharger gear, radiator shutters closed, at 243 knots ASI (zero elevator trim) the aircraft was dived to the limiting speed of 304 knots ASI.

The forward stick forces to hold in the dive was 8 lb. On release of the control column the tendency to build up acceleration was less marked than at the previous loadings shown above, but a restraining force of 16–18 lb. was required to restrict the acceleration in recovery to 2.5g.

As the speed in the dive increased over 260 knots ASI a very slight high period vibration was felt which was attributed by the pilot to the carriage of the mine.

4.26 Flight Under Asymmetric Power. The effects of engine failure at take-off have been reported under para.4.22.

Loading 2(a) (No external stores). With the propeller of the starboard engine windmilling at 1800 rpm (propeller set to fully coarse pitch and radiator closed) and with the port engine working at 2850 rpm, +9 lb/sq. in. boost, radiator open, the aircraft maintained height at 7000 ft. at 167 knots ASI. Full left rudder trim was necessary and there remained a very light footload, which was not tiring to maintain. The aircraft could be climbed at 152 knots ASI at approximately 100 ft. per minute, but there was a moderate footload which would prove tiring. The aileron trim was set ½ division to the left.

With the starboard propeller feathered, the aircraft maintained height at 170 knots ASI and at 165 knots ASI there was no footload with full left rudder trim.

Tests were not repeated with the port engine dead as this case was known to be less severe.

4.27 Approach and Landing.

4.271 Loading 2a (No external stores).

(a) Under normal conditions, engine assisted (3000 rpm, and +1 lb./sq. in. boost) approaches were made at speeds down to 87 knots ASI. The aircraft was fairly steady and despite some slight fore and aft movement of the control column there was no corresponding alterations in the indicated airspeed.

Gentle turns were made satisfactorily by use of ailerons. On throttling back the engine over the selected landing spot, the aircraft dropped onto three points, although there was a tendency to bounce on the grass airfield.

(b) In disturbed air conditions, the approach at slow speeds was somewhat complicated by the fore and aft hunting of the control column, a feature which had been found to have been accentuated by the larger horn balance.

The elevator trimmer was wound fully forward for the approach at slow speed with engine on and a forward stick force was also necessary. This stick force varied from 10 to 15 lb. with speed and power employed but was not found to be excessive owing to the favourable position of the pilot in relation to the control column.

(c) Baulked Landing. Trimmed for the approach at 104 knots ASI, 3000 rpm, zero boost, flaps and undercarriage down, radiators open, the elevator trimmer was set 2.5 divisions nose heavy. Opening up the engines to 3000 rpm, +17 lb./sq.in. boost, the stick force required to maintain a climb away at 104 knots ASI.

The flaps were retracted after gaining 500 ft. in height at 130 knots ASI and retrimming in a tail heavy sense was made to counteract the associated nose down change of trim.

4.3 Longitudinal Change of Trim with Speed and Power. The following table gives the elevator trimmer settings for various conditions of flight.

Condition	Loading (see para.2.6)	Trimmer setting	ASI knots	RPM	Boost lb./in. 2	Rad. Flap shutter	Remark
Take-off	1a, 2a	0.5 NH	80	3000	+18	Open	15° of flap
	1b, 2a	0.5 NH	87	3000	+12		
Climb	1b	1.0 NH	148	2850	+9	Open	

	2a	0.1 NH	148	2850	+9		
Slow	1b	0.9 NH*	148	2400	–4 ½	Shut	
Cruise	1b	1.0 NH*	192	2300	0		
	2a	0.1 TH	187	02300	0		
Cruise	1b	1.0 NH*	234	2650	+7		
	2a	Zero	230	2650	+7		
Combat	2a	0.2 NH	247	3000	+16 ½		
Level	2b	0.1 NH	251	3000	+16 ½		
	2c	Zero	243	3000	+17		
Glide	1b	2.2 NH	117	–	–		Flaps & U/C down
Engine on	1	2.5	105	3000	0	Open	Flaps & U/C
approach	2a	2.5	104	3000	0		down
	2a	3.7	87	3000	0.7		

* Aircraft would not fly “hands off” and trimming was difficult (see para.4.11).

It will be seen from the above that for a given loading, increased trim to nose heavy is required with increase in speed or with increase in power.

4.4 Effect of Carriage of External Stores. Except as previously mentioned (see paras.4.222, 4.253), the carriage of the external stores selected produced no material adverse effects and in general produced no noticeable effect on handling characteristics of the aircraft.

The asymmetric loading arising from loading 2b, (carriage of two MK. VIII mines under the wing), when one mine remains under the wing, had very little effect on the handling of the aircraft. A very small amount of aileron and rudder trim were required which decreased with increase of speed. Cruising at 226 knots ASI the rudder trimmer was 0.3 division to the right, and the aileron trim 0.5 division to the right. These trimmer settings were left for the dive to 302 knots ASI, and resulted in no adverse characteristics. The stick forces involved in the dive were the same as in the symmetrically loaded case.

5. Conclusions.

As first tested with the normal (6.9%) elevator horn balance, the longitudinal behaviour with the c.g. at 17.7 ins. and 17.1 ins. aft of datum (undercarriage down) was considered to be unacceptable.

With the larger horn (9.75%), c.g. at 16.9 ins. aft of datum (undercarriage down) the longitudinal behaviour was much improved and was normal in

general handling for a production Mosquito VI, (3-bladed propeller, 6.9% horn, same weight and c.g. position), except for a slight inferiority in longitudinal behaviour at low speeds as on the approach to land. A slight fore and aft hunting of the control column previously noted on other Mosquito variants fitted with this larger horn was present which might prove disconcerting to an unwary pilot on the approach to land in disturbed air conditions.

In the recovery from out of trim dives there was a tendency to tighten up in the recovery, so that a restraining force was necessary to prevent excessive 'g'. This tendency is not abnormal for a Mosquito VI (see 14th part of this Report) but it is recommended that:-

(i) The aft most e.g. position for the Sea Mosquito should be restricted to 16.0 ins. aft of datum, undercarriage down, and the limitation in maximum speed should not be raised above 347 knots ASI.

With the e.g. at 16.9 ins. aft (undercarriage down) the handling is recommended as acceptable only as an emergency measure, and with the proviso that the pilots are warned of the low stick forces encountered in untrimmed dives, and of the tendency to tighten up in the dive recovery.

(ii) Further tests should be made by the Firm on a production Sea Mosquito TR 33 to confirm the aft most e.g. position in view of the known variation of the diving characteristics with small changes in the tailplane setting.

In addition it is recommended that:-

(iii) It should be stressed that it is desirable to throttle back to +12 lb/sq.in. boost as soon as possible after take-off to minimise the yaw consequent upon the failure of one engine.

In general, the aircraft was considered pleasant to fly and the addition of the external stores made no material differences to the handling features.

OPERATIONS RECORD BOOK OF NO.105 SQUADRON, SEPTEMBER 16–28 1942

Place	Date	Time	Summary of Events.
Horsham St Faith	16.9.42		Six Mosquito aircraft took off for dusk attack on Wiesbaden Chemical Works. 1. Flight Lieutenant Parry and Pilot Officer Robson – Abandoned task through instrumental failure. 2. Flight Lieutenant Ralston and Pilot Officer Clayton – Primary attacked from 3,500 feet. 3. Warrant Officer Boois and Flight Sergeant Jackson – Primary attacked from 2,500 feet. 4. Flight Sergeant Monaghan and Sergeant Dean – Primary not attacked owing to falling light. Factory in Wiesbaden area bombed instead. 5. Sergeant Booth and Sergeant Turner – Primary attacked from 4,000 feet. 6. Pilot Officer Land and Flying Officer Thomas – Primary attacked from 3,500 feet. Engine trouble on homeward journey and landed at Bodney.
Horsham St Faith	18.9.42		Three Mosquito aircraft took off early afternoon on roving commission. 1. Pilot Officer Rowland and Pilot Officer Kelly for Wilmershaven area. Abandoned task owing to insufficient cloud cover. 2. Pilot Officer Bristow and Pilot Officer Marshall – Bremenhaven area, no target attacked owing to lack of cloud cover Area from mouth of Elbe to Den Helder searched for one hour without success. 3. Sergeant Smith and Sergeant Barstow – Emden arch. Island attacked believed Borkin. Bombs fell in sea.

Place	Date	Time	Summary of Events.
Horsham St Faith	19.9.42		Six Mosquito aircraft took off about 12.30 hours for high level attack on Berlin. 1. Sergeant Booth and Seargeant Turner – abandoned task owing to aircraft losing height. 2. Flight Officer Monaghan and Sergeant Dean – abandoned task owing to other aircraft in formation being attacked by fighters at 26,000 feet. 3. Flight Lieutenant Ralston and Flight Sergeant Armitage – Primary target not attacked owing to cloud. Bombs dropped in Hamburg area though 10/10 cloud on D.H. Accurate heavy flack encountered over Bremen. 4. Flight Lieutenant Parry and Pilot Officer Robson – Primary target not attacked owing to 10/10 cloud. Bombs jettisoned live in Hamburg Area while being chased by fighters. Intercepted four times and eventually damaged by two F.W. 190's. 5. Squadron Leader Messervy and Sergeant Holland – This aircraft did not return. Believed to have been shot down by enemy fighters 52˚40'N, 08˚ 29'E. 6. Warrant Officer Boois and Sergeant Jackson – Target area bombed through 10/10 cloud on D.E.
Horsham St Faith	21.9.42		Squadron Leader P. Channer left on posting to No. 1655 Flight. Warrant Officer T.R. Williams joined the Squadron on posting from Horsham St. Faith Station.
Horsham St Faith	22.9.42		Three Mosquito aircraft took off in morning for low-level attack on Leimuiden Steel Works 1. Flight Lieutenant Ralston and Flight Sergeant Armitage – attacked coke ovens which were believed hit, but bursts not observed. 2. Warrant Officer Roseda and Sergeant Urquhart – unable to identify target. Large factory at Haarlem attacked as alternative. 3. Pilot Officer Lang and Flying Officer Thomas – Primary target not attacked. Gasworks at Haarlem attacked as alternative.
Horsham St Faith	24.9.42		In the afternoon three Mosquito aircraft took off to attack target as above. 1. Flight Lieutenant Patterson and Sergeant Egan – Attacked primary target. Bombs believed to have fallen on coke oven, but bursts not observed. 2. Flight Officer Bristow and Pilot Officer Marshall – Primary target successfully attacked, but bursts not observed. Direct hit in fuselage by light flack caused considerable damage to aircraft. 3. Pilot Officer Bruce and Pilot Officer Carreck – Attacked primary target, but bursts not observed. The following crews left on detachment to Leuchars: Wing Commander Edwards and Pilot Officer Cairns, Squadron Leader Parry and Pilot Officer Robson, Pilot Officer Rowland and Pilot Officer Reily, Pilot Officer Bruce and Pilot Officer Carreck, Flying Officer Bristow and Pilot Officer Marshall and Flight Sergeant Carter and Sergeant Young.

Place	Date	Time	Summary of Events.
Horsham St Faith	25.9.42		Four Mosquito aircraft of this Squadron took off from Leuchars in early afternoon for attack on special target in Oslo. 1. Flying Officer Bristow and Pilot Officer Marshall – Attacked target successfully from 100 feet. Was attacked over target by two F.W. 190's, which were successfully evaded. Landed at Sumburgh on return. 2. Pilot Officer Rowland and Pilot Officer Reilly – attacked target successfully from 100 feet. Was attacked by a F. W. 190 after leaving target. Aircraft was damaged by cannon-fire but eventually drew away from the F. W. 190 and landed safely at Sumburgh. 3. Squadron Leader Parry and Pilot Officer Robson – Attacked target successfully from 100 feet. Was attacked by two F.W. 190s over target but evaded them. Direct hits observed on central building. Aircraft landed at Sumburgh. 4. Flight Sergeant Carter and Sergeant Young – This aircraft was attacked by a F. W. 190 over the target and was last seen heading into Oslo Fjord with smoke pouring from starboard engine. It failed to return.
Horsham St Faith	26.9.42		The crew who left on detachment to Leuchars on the twenty fourth returned to Horsham St. Faith today, except the one missing crew (Flight Sergeant Carter and Sergeant Young). One aircraft took off mid-afternoon for Meteorological reconnaissance of Hamburg–Kiel area. Reconnaisance successfully carried out and no opposition encountered.
Horsham St Faith	28.9.42		Sergeant Lawson (Navigator S. W.) arrived on posting from No 487 Squadron.

A.C.A.S. (Ops.)

D.D.E.8.
A.D.O.A.
A.D.O.F.

D.F.Ops.

Signals Plans
H.Q. Fighter Command

D.C.N.O.

H.Q. 44 Group

D. of Movements
D.D.O.2.
D.D.S.M.1.

MOSQUITO INTRUDER SQUADRON FOR MALTA

1. It has been decided that No.23(F) Squadron is to be despatched as soon as possible from this country to operate temporarily in Malta. The squadron is not to be struck off the strength of Fighter Command.

AIRCRAFT

2. 18 Mosquitoes (i.e. 16 I.E. plus 2 I.R.), which are not to be tropicalized or specially camouflaged, are to be provided under H.Q. Fighter Command arrangements. Aircraft and air crew are to be ready for despatch to Malta under H.Q. 44 Group arrangements by 16th December, 1942.

AIR CREWS

3. 18 air crews, including the Squadron and Flight Commanders of No.23 Squadron, are to be provided by Fighter Command. They are, so far as possible, to be the air crews now in No.23 Squadron. If, however, any of these are not sufficiently experienced to undertake the flight to Malta or to operate on arrival there, they are to be replaced by more experienced crews under H.Q. Fighter Command arrangements.

4. Air crews are to be kitted, inoculated, etc., to Middle East scales under H.Q. Fighter Command arrangements.

MAINTENANCE PERSONNEL.

5. A limited number of key maintenance personnel from No.23 Squadron is to proceed by sea to Gibraltar, thence to Malta by air shuttle service.

6. The composition of the party is to be decided by H.Q. Fighter Command in conjunction with Air Ministry D.D.S.M.1. The number is to be kept to a minimum and should not exceed fifty.

7. The party is to be ready to leave the parent station on 10th December, 1942, for embarkation. The movement order will be issued by Air Ministry D. of Movements.

8. The weight of personal baggage to be taken by this party is not to exceed 30-lbs. each, excluding steel helmets, gas masks, arms and accoutrements. If time permits the party is to be kitted, inoculated, etc., to Middle East scales under H.Q. Fighter Command arrangements.

MAINTENANCE SPARES AND EQUIPMENT

9. H.Q. Fighter Command is to arrange for packup of essential spares and equipment to be packed for transportation to Gibraltar by sea and thence by air to Malta.

10. This packup is to be ready for movement on 10th December, 1942, under arrangements to be made by Air Ministry D. of Movements. Tool kits and fight tool kits are to be taken by the maintenance party.

11. A further packup is to be prepared under Air Ministry D.D.E.8. arrangements and shipped to Gibraltar at the earliest possible date. It is to be sent as opportunity offers into Malta from Gibraltar by air.

12. Action to implement the above is to be taken by all concerned.

6th December, 1942. D.W.O.

[Signed, Group Captain A W Davies, for]

SECRET.

D.D.O.Ops.

NO.23 SQUADRON, MALTA.

Supply of Aircraft.

1. On the 7th May, according to W.O.7's return, the strength of aircraft in the Squadron was

6 Cat. "A"
1 Cat. "B"
4 Cat. "D"

2. Since that date two aircraft have returned to this country for major overhaul.

3. The Squadron took 16 Mark II aircraft with it to Malta in December 1942. The wastage quota was

4 for January
4 for February
4 for March
5 for April
6 for May

They have received

1 in January
1 in February
7 in March
2 in April
Nil in May

You will see that as against a wastage due of 23 up to the end of May they have received 11. The only reason 0.7(b) can give me for this shortage of supply is the fact that long range tanks were not available owing to them all being earmarked for an operation which we discussed sometime ago. You

may remember that D.W.O. was approached and tanks were released but that is sometime ago now and still no aircraft have gone.

4. In addition to the above commitments 6 further aircraft are due to go out this month in replacement for time expired aircraft which are coming or have come home for major overhaul.

5. 0.7(b) tell me that they hope to get aircraft away at the following rates:-

1 Mark II by 23/5
1 Mark II no date known
4 Mark VI by end May
Further Mark VI at present in 44 Group by end May.
5 further Mark VIs they hope to be delivered to 44 Group in time to leave by the end of May.
6 Mark VIs – no firm forecast of date available but they hope first week in June.

6. I think it might be worth while raising this point at the morning conference to get pressure brought to bear on D.D.O. (A) via D.W.O. to ensure that at least they adhere to the present unsatisfactory programme.

Re-inforcing Crews.

7. No.23 Squadron relied on the crews going out with re-inforcing aircraft for their re-inforcing crews. From the previous paragraphs in this minute you will see that the aircraft have not gone out therefore only a few re-inforcing crews have gone out. The present STRENGTH OF PILOTS is as follows:-

1 new Wing Commander
3 Flight Lieutenants
1 Warrant Office
2 Sergeants

against an I.E. of 22 PILOTS. Of the above one Flight Lieutenant is tour expired, the two remaining Flight Lieutenants have only got a month or two to go and the Warrant Office has also only a month or two to go. In company with Squadron Leader Starr (late of 23 Squadron) I discussed the matter with D.P.6 (Mr. Hockley) and Flight Lieutenant Mc Keown of D.P.2. They say that they have produced the trained crews with operational

experience from Fighter Command and some of them have been waiting for aircraft IN 44 Group from upwards of one month. Squadron Leader Starr tells me, But I have been able to verify it, that 23 Squadron signalled home early in April asking for two new Flight Commanders (Squadron Leaders). None have so far gone out. I understand that one, Squadron Leader Brown, is waiting to go OUT 15 held up for aircraft but he may have gone today. I impressed upon D.P.6. and D.P.2. that it was essential that first class and experienced crews should go out with the next re-inforcing aircraft as the Squadron was now so low that nothing else could hope to build it up. They agreed that they would do their best.

8. I do not know whether you think it necessary to send a brief minute to D.G. of P. pointing out the position and inviting him to take an interest in the matter? My impression was that D.P.2. would do all they could but I am not sure whether they have enough “guns” to ensure that the right people go out.

Spares.

9. In company with Squadron Leader Starr I interviewed Wing Commander Jackson and Squadron Leader Fergusson of E.16. I informed them that 23 Squadron had to all intents and purposes existed so far as spares were concerned on bits they could take off unserviceable aircraft. The spares arrangements made by the Air Ministry consisted of the following:-

(i) A 3 months pack-up of essential spares for MOSQUITO IIs thought to have left by sea in January or February for Gibraltar. They were to go by air from there to Malta and therefore were very limited with regard to weight with the result that no engines went to Malta.

(ii) A 9 months pack-up has been sent by the long route i.e. Cape Middle East containing the necessary additional equipment NECESSITATED BY the substitution of Mark VI fighter/bomber MOSQUITOES FOR the Mark II MOSQUITOES originally sent out with the Squadron.

E.16 tell me that they expected Malta to signal home their further spares requirements but so far they have received practically no demands. E.16 yesterday despatched a signal to Malta asking them if they had any

requirements for spares for 23 Squadron. They promised to inform us of their reply. We know from information supplied by Squadron Leader Starr that they have no Merlin 21 engines in Malta and that they had in point of fact been trying to convert a Merlin 12 (?) belonging to a WELLINGTON as a replacement for a MOSQUITO and that they have in fact fitted some Merlins out of HURRICANES into other MOSQUITOS as replacements. As the aircraft at present in Malta are practically all due to come home for major overhaul and new aircraft are going out it would seem that no useful purpose would be served at the moment by sending out spare engines until we get Malta's reply to what spares are required.

Overheating.

10. In their signal T.537 of the 27th April, Malta complained of overheating in the MOSQUITO aircraft of 23 Squadron. The matter was raised at the morning conference by A.C.A.S. (Ops.) and A.C.A.S. (T.R.) confirmed that the matter had been referred to the M.A.P. for urgent consideration. The fact remains that at the moment no reply has gone to Malta's signal dated 27th April.

11. This morning in company with Squadron Leader Starr and Squadron Leader Johnston (D.O.R.) I visited M.A.P. and discussed the matter with D.D/R.D.A. Apparently the matter has been under consideration but M.A.P. and 23 Squadron do not seem to agree as to the maximum temperatures at which engines can safely be run, the latter saying that 110º from their experience is unsafe and at 120 the glycol starts coming out of the breather. M.A.P. however seem to think that 115º is quite all right. As a result of the conversations it became apparent that Coastal Command had had similar troubles and it had been suggested that the troubles were due to unsatisfactory controls for the radiator shutters. Coastal Command find it necessary to adjust these so that the radiator shutter is slightly open. D.D/R.D.A. are passing a draft signal today to D.O.R. for immediate despatch to Malta telling them of this.

12. I raised the question of substituting water for glycol but the cooling arrangements of the MOSQUITO operate under pressure and water cannot be substituted for glycol.

13. During the discussions it became apparent that the present type of engine, the Merlin 21, is designed for high altitude flying and therefore is a fully blown engine. Intruder Squadrons never in the course of their normal intruder duties fly above 6,000 ft. and therefore the Merlin 21 is a very unsuitable engine for their role. It was suggested that the better engine is a Merlin 25 which gives best results at low altitudes. In point of fact at 2,000 ft. the maximum speed for a MOSQUITO fitted with Merlin 25 engines is some 40 m.p.h. more than for a MOSQUITO fitted with a Merlin 21. It transpired that Fighter Command had already raised this matter and that certain MOSQUITOS were being fitted for Fighter Command with Merlin 25s. It was thought that this might also assist in overcoming the excessive temperature of the coolant. I think we should raise the question of having Merlin 25s fitted in all MOSQUITOS being sent overseas for intruder duties.

14. During these discussions it was clear that the temperatures can be reduced by fully opening the radiator shutters but it is not a practicable operational proposition because it means an immediate drop of 15 m.p.h. IN cruising speed.

Tropicalisation.

15. I obtained from M.A.P. a leaflet on tropicalisation of MOSQUITOS. This consists of

(i) fitting tropical air intakes – 8 man hours,
(ii) fitting sun screens on the cockpit canopy,
(iii) fitting desert equipment,
(iv) fitting fuel cooling radiator – 6 man hours,
(v) fitting ground equipment for tropicalised aircraft.

16. Of the above it appears that only (i) and (iv) which take 14 man hours, are necessary. The total man hours for the whole of the above tropicalisation are assessed as 25. I am assured, however, by 0.7(b) that it is not the tropicalisation that is holding up the despatch of aircraft. I think however that we should pass a minute through D.O.R. asking them to agree that the appropriate authorities should be informed that no hold up in the despatch of aircraft can be agreed to for tropicalisation except for the fitting of Modifications (i) and (iv).

O. Ops. 1.
20.5.43. Wing Commander Pain.

SECRET

NO.23 (MOSQUITO) SQUADRON

1. No.23 Squadron, Malta, are having difficulties which can be divided under four headings:-

(i) Supply of aircraft
(ii) Supply of spares
(iii) Supply of reinforcing crews
(iv) Over heating of aircraft.

2. Reference 1(i), the position with regard to aircraft is as follows:-

16 Mark II arrived with the squadron in December
1 ” ” replacement arrived in January
1 ” ” ” ” ” February
7 ” ” ” ” ” March
2 ” ” ” ” ” April
27

The I.E. of the squadron is 16 aircraft; the W.O. strength on 7th May showed 6 Cat.A, 1 Cat.B and 4 Cat.D. Since 7th May 2 aircraft have returned to this country for major overhaul. The quota for April was 6, and for May is 12. Of these 18 aircraft only 2 have so far arrived in Malta. The question of the allocation and despatch of the remaining 16 aircraft is being taken up with S/Ldr. Kinsman of 0.7(b).

Since the arrival of the squadron in Malta, as an approximate of spares and S/Ldr. Starr, who is a time-expired Flight Commander, has brought back a list of small spares, attached at Appendix ‘A’ [not reproduced here], which are immediately required , and it is hoped to get these packed and flown out by the first available reinforcing aircraft.

This is only a small part of the spare shortage. There are many major spares also required, i.e. engines. As an example: Malta have been endeavouring to modify an engine from a Wellington as a replacement engine and have, in point of fact, been fitting Hurricane engines into the Mosquitoes of 23 Squadron in order to keep them serviceable. The whole

question of spares is being discussed in detail with W/Cdr. Jackson of E.16, Woburn Place, forthwith.

3. With regard to para. 1(iii) the situation is also serious. There is a new W/Cdr. commanding the squadron. Both the Flight Commanders have come home, tour-expired. There are left behind 3 F/Lts., of which 1 is time-expired, and 3 other crews the pilots of which are a Warrant Officer and 2 Sergeants. The 2 F/Lts. who are not tour-expired have only got a month to 2 months to do, and the Warrant Officer is in the same category as the 2 F/Lts; the 2 Sergeant Pilots have got about 40/50 sorties to do.

4. With reference to para. 1(iv) above, the over heating trouble was reported to the Air Ministry in Malta signal T.537 of 27th April. This has been under discussion between S/Ldr. Johnston of D.O.R., and M.A.P., and S/Ldr. Starr are going to see M.A.P's representative today on the matter.

Further to note of action above. Interviewed S/Ldr. Kinsman (0.7(b)) with S/Ldr. Starr and discussed the supply of aircraft. The position is as follows:-

Outstanding to end of May: 2 Mark IIs
16 Mark Vis

Despatch position: 1 Mark II should leave by 23 May
1 " II held up, reason unknown
4 " VI should leave by end of May
1 " VI in 44 Group, expected to go by end of May
5 " VI should be delivered to 44 Group by 22 May and leave by 31 May
6 " VI. No date available yet but it is hoped they will leave by first week in June.

2. <u>Spares.</u>

Spoke W/Cdr. JACKSON and S/Ldr. Ferguson (E.16) with S/Ldr. Starr. The former agreed to arrange for the pack-ups suggested in Appendix 'A' [not reproduced here] to go out on the 18 reinforcing Mosquitoes subject to the pack-ups being ready before the aircraft leave. They will arrange for 44 Group to lay on similar pack-ups for subsequent reinforcing aircraft.

The major spare position is as follows:-

3 months' essential spares pack-up for Mosquito IIs should have left by sea during January or February for Gibraltar from where they were to be sent by air, hence the spares which could be sent were considerably limited as to weight and did not include any engines. It was understood that there were spare Merlin XXI engines in Gibraltar.

There is no information available as to whether these pack-ups ever reached them; S/Ldr. Starr thinks that a few spares have arrived since the squadron have been in Malta.

A 9 months pack-up of spares for converting Mark IIs to Mark VIs have been despatched to Malta via the long route and Middle East, but I do not know when these are due to arrive – in any case it will be some very considerable time.

19th May, 1943

Ops.1. (W/Cdr. Pain)

23 SQDN. MOSQUITO INTRUDER PATROLS

1.1.43-4.9.43 (INCLS)

1943

January.	1 – 2	7
	3 – 9	27
	10 – 16	39
	17 – 23	51
	24 – 30	45
	31/1 – 6/2	31
February.	7 – 13	25
	14 – 20	22
	21 – 27	38
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A.M.W.R. ..... S/O
Statistical Section. for Wing Commander.
6.9.43

23 SQUADRON OPERATIONAL ANALYSIS

FIGHTER – BOMBER OPERATIONS

COMMAND

Command Reference	Date of Operation	Number and Type of A/c.	Location	Targets	Remarks or Results	Casualties	
						Enemy a/c	Own a/c
	2-3/3	9 Mosquitos	ROVIEGO/ RAVENA/ CESTI/CASTEL MAGGIORE/ VIAREGGIO	Intruder patrols against railways	Strafed 2 locomotives and trains, oil tanks. Destroyed 3 M.T.		1 Mosq. missing
	7-8/3	7 Mosquitos	TORRE DEL LADO	M.T. factory and building.	Attacked with 500lbs. bombs.		
			LAKE COMACCHIO	Jetty	Attacked with 500lbs. bombs, opposition from ships in LEGHORN area.		
	8-9/3	7 Mosquitos	MARSEILLES/ BORDEAUX/ TOULONS/West ITALY	Intruder patrols.	Bombed bridge and town South of OSTIGLIA. Set bridge on fire at ROVOGO. Bombed M/V destroyed OFF LEGHORN. Strafed 2 trains, M/T and station yard.	2 He.111 destroyed	

	10-11/3	12 Mosquitos	PO VALLEY	Intruder patrols on railway	Bombed bridges with unobserved results. Near misses bridge at OSTIGLIA. Strafed trains, M.T., stations, bridges and tugs.		
	16-17/3	9 Mosquitos	S. of FRANCE	Intruder patrols	No enemy air activity.		
	24-25/3	4 Mosquitos	MARSEILLES/ TOULOUSE area.	Intruder patrols	No incidents due to weather.		
		1 Mosquitos	FORLIRABENNA	Intruder patrols			
		8 Mosquitos	MARINA DI PISA etc	Factory, Chemical works, Airfields	Explosions and fires, unobserved results.	1 e/a dam.	
	25-26/3	4 Mosquitos 2 Mosquitos 6 Mosquitos	LAKE BECCARES TOULOUSE CENTRAL ITALY	Intruder patrols Intruder patrols Intruder patrols	Strafed goods train. Bombs dropped on railways at ORVIETO and FOLLONICA, M.T. at HAGLIANO, PISA, CAMPAGNANO, trains at CIVITANOVA and ALBINIA. Train at ALBINIA exploded. Concentrated M.T. at LAKE PRACCANO and TORRE DEL LADO also bombed.		

	25-26/3	3 Mosquitos	S. of FRANCE and N.E. ITALY	Intruder patrols	Without incident.		
	26-27/3	7 Mosquitos	Intruder patrols	Not stated			
	27-28/3	10 Mosquitos	TALMONE LAKE BOLSENA PESARO FORLI ISTRES	Railway station. M.T. convoys to East of M.T. and bridge to North. No targets seen landing ground in MARSEILLES/ MONTPELLIER area	Near misses on bridge only.		
	29-30/3	8 Mosquitos	Between BOLOGNA and IMOLA TALAMONE	2 trains between Railway	Strafed 5 aircraft bombed and strafed train and several M/T vehicles one of which exploded.		
	1-2/4	13 Mosquitos	ALESSA PISA FLORENCE CHINSI LADISPOLI CECINA FORLI	Road and rail targets	Intruder patrols 12 bombing and straffing attacks on roads and rail targets these areas. Many trains bombed and strafed.		

	2-3/4	10 Mosquitos	LAKE VENETA PISA FLORENCE TRASIMENO	Rail targets	11 despatched but one returned early due to engine trouble. Intruded N. ITALY, PO VALLEY, bombing road and rail targets. Strafed 2 trains.		
	7-8/4	16 Mosquitos	N. of ROME	Continuous night patrol railways and roads.	Dropped 32 × 250. Also 23 attacks on M.T.		
	9/4	4 Mosquitos	S. of FRANCE	Range patrols	Strafed 3 Do.217s Perpigion A/F, left one in flames. Strafed 6 trains, 3 petrol wagons, 3 fuel containers and factory buildings at NISSAN. Also rollingstock at AGDE, BEXIERS and NARBONNE. Gasometer fired at AGDE.		
	11/4	4 Mosquitos	NARBONNE area	Intruder patrols	Attacked 16 trains in sidings. Destroyed 2 locomotives, damaged others.		

	11-12/4	9 Mosquitos	PIOMBINO PERUGIA VITIRBO ORVIETTO.	Offensive patrols	Rail targets and road attacked. 6 trains damaged, 1 direct hit, 14 attacks on M/T. Strafed ORVIETTO goods yards.		
	12-13/4	9 Mosquitos	VETRALLA MONTE ROTONDO FLANO ROMANA	Intruder patrols	Bombed communications starting large fires. Damaged locomotives and strafed M/T.		
	19-20/4	8 Mosquitos	N. of ROME	Intruder patrols	6 bombing and 29 cannon attacks on M/T and 2 trains. Unobserved results due to weather.		

ACCOUNT OF THE AMIENS PRISON OPERATION.

The Mosquitos of the Second Tactical Air Force have performed many difficult and during operations since they joined T.A.F., including the destruction of the single building German Headquarters of Civil Administration in the centre of the Hague, numerous Army Barracks, or Chateaus converted for occupation by German Troops in France, German Army Headquarters in the Field, Electric Power Stations, and other targets of the most exacting precision, but of all they count as the most intricate – (and they should know), a certain operation carried out on the 18th February this year against the Civil Prison at Amiens.

Information was received by the Air Ministry, that over 100 loyal Frenchmen were lying in the Prison at Amiens awaiting death for their brave efforts in the Allied cause; some had been condemned for assisting Allied airmen to escape after they had been brought down in France. The Free French authorities were pressing for an R.A.F. attack on the Prison, under cover of which it was hoped that as many as possible of the prisoners would escape prior to the date on which the first executions were due. The Prison was a cruciform building in a court-yard surrounded by a twenty feet high wall, nearly three feet thick. The yard was fenced internally to segregate the prisoners whilst at exercise. Accuracy in attack would be essential, for whilst on the one hand the walls and buildings required to be breached, on the other it had to be ensured that only the minimum necessary force would be used, to reduce casualties – for obvious reasons, to the minimum. The Prison was guarded by German Troops living in a special wing, the location of which was exactly known. The attack had to be sufficiently discriminating to ensure decisive force being used against this portion of the building. The time factor too, was important, for the escapees were to receive valuable assistance by patriots from outside, if the latter could be warned of the exact time of attack. The task called for secret and detailed planning and a model of the Prison and its surroundings was made from photographs and other information already in the Air Ministry's

possession. Thus in planning and briefing, every aspect was studied. This unique task, was allotted to a Mosquito Wing comprising British, Australian, and New Zealand Sqdns Commanded by Group Captain P.C. Pickard, D.S.O., D.F.C., one of the most outstanding and experienced Bomber Pilots in the R.A.F. It was decided to allocate two Fighter Squadrons for escort duties, from a Group in Fighter Command that played a memorable share in the historic Battle of Britain.

On the morning of the 18th February, Group Captain Pickard's Squadrons rose before dawn for their very careful briefing, to find the Airfield covered with snow and low cloud, and with very little prospect of clearance. Once the plan was outlined the crews, the most experienced from each Squadron, were determined to press home their attack in spite of the weather.

It was obvious that the Prison walls must be broken in at least two places in order to enable any escape at all. At the same time both ends of the main building had to be hit to release the prisoners from their confinement. To this end, the first wave of six aircraft was detailed to breach the wall on its N.E. and N.W. perimeter. The second wave of six aircraft was to divide and open up both ends of the Prison, and to destroy the Guards quarters. A third wave was available should any part of the plan miscarry. To obtain the accuracy required, it was necessary to bomb from 'deck level' and each wave had to be so timed that the results were achieved in their right sequence and to avoid casualties by collision over such a small target. A Mosquito was allotted to the operation to record photographically the attack.

It was an hour before mid-day as the Squadrons left their snow covered Airfield, to make rendezvous with their Fighter escort on the South coast. From there the formation flew at sea level to the Coast of France, swept round the North of Amiens and approached along the straight Amiens – Doullens road on which the Prison was located.

The second wave on approaching saw that the first wave had been successful. Through the dust and smoke of the bombing the corners of the Prison were seen enabling an accurate attack to be made. This, too, was so successful that Group Captain Pickard circling the target was able to send the third wave home without any necessity for their attack. A photographic Mosquito made three runs over the target, and saw the breaches in the wall, the ends of the building broken, prisoners running out through the breaches,

Huns lying on the ground, and on the last run some Patriots were seen disappearing across the snow covered field outside the Prison.

The operation was not carried out without losses, for two Mosquitos, one of which carried Group Captain Pickard and his Navigator, Flight Lieutenant Broadley, was lost through enemy Fighters, as also were two of the Fighter escort. Despite these losses it was a source of tremendous satisfaction, particularly to the crews who took part, when it was learned that a large percentage of the Patriots had escaped, and though as was unavoidable some were killed by German machine-guns as well as the bombs, the Germans themselves suffered considerable casualties from the attack. It is not possible to give the exact figures for security reasons.

Since the successful invasion of Normandy and subsequent re-occupation of Amiens by the Allies, it has been possible to piece together certain details – particularly of our losses, which up till then had been outstanding. All that was originally known of Group Captain Pickard's fate was that his aircraft was last seen circling over the Prison slightly above the height at which the three waves of Mosquitos were attacking. His purpose was to decide whether, or not sufficient force and accuracy had been achieved by the first two waves, and to order the reserve wave to attack, or withdraw accordingly. It was for this reason that he had detached himself from the main formation, to a position from which, though it was dangerous, he could best see and direct the operations. It now seems certain that when he had ordered the last wave to withdraw without dropping their bombs, he saw one of his Mosquitos brought down by the fierce Light Flak put up by the German defences. Bent on investigating the crash to discover the fate of the crew, he was himslef 'bounced' by a pair of FW.190's sent up by the Huns to intercept our aircraft. Caught thus pre-occupied, and detached from the friendly Fighter escort, which by then was covering the withdrawal of the main formations, he fell an easy victim to the more heavily armed and faster enemy fighters. He was shot down a few miles from Amiens, and his body with that of his Navigator was subsequently recovered by friendly Villagers, who had witnessed the whole episode. The Germans forced the Villagers to hand over the bodies, but were unable to prevent them attending the burial in the Cemetery alongside Amiens Prison. As soon as his comrades reached Amiens, after the invasion, seeking news of his fate, the Villagers presented them with photographs the Germans for the six

months prior to the invasion, in order that his identity and that of his Navigator might definitely be established. Tragic though Pickard's loss is, there is consolation in the knowledge that it occurred whilst he was leading probably the most successful operation of his gallant and brilliant career.

The attack on Amiens Prison will remain one of the R.A.F.'s epics.

OPERATIONS RECORD BOOK OF NO.105 SQUADRON, 1 APRIL TO 9 JUNE 1944

Place	Date	Time	Summary of Events.
Bourn	1.4.44	Day	P/O L.C. Poll (Nav) promoted to the war substantive rank of Flying Officer War 8.3.44
		Night	Two out of three aircraft attacked Aachen, dropping 6 x 500 M.C. and 2 x 500 G.P.L.D. in weather varying from clear skies to 5/10 cloud. No results were seen and opposition was not very heavy, consisting of slight to moderate heavy flak and a cone of about 20 searchlights, which held our aircraft for a few minutes. F/L Ackroyd attacked a last resort target. Three aircraft took off to bomb the Deutsche Edelstahlwerke A.C. at Krefeld, but due to technical failures no one was able to identify the primary target. Two aircraft attacked the Krefeld area dropping 6 × 500 M. C. and 2 × 500 G.P.L.D. through thin cloud. Many searchlights were in operation and later the aircraft were coned for some minutes but the flak was only slight. F/Lt. Ford attacked the Duren area with 3 × 500 M. C. and 1 × 500 G.P.L.D. through 7/10 cloud. Opposition was very weak.
	2.4.44	Day	F/Lt. A. Haworth IFC (nav) and P/O. I.B. McPherson (pilot) temporarily awarded the Path Finder Force badge. F/O J.A. Ruck, F/O. E.L.D. Drake (pilots) F/O. C.E.J. Colvin DFC and W/O. L. B. Winsloe (navigators) posted this unit from 1655 M.T.U.
	4.4.44	Day	F/O. H. L Plimmer (navigator) promoted to the war substantive rank of Flight Lieutenant.
		Night	The Command's main attack was made by 41 Mosquitos on Cologne, four aircraft of the Squadron acting as primary markers with 1 × Green T.I.L.B. + 1 T.L. Green (Floater) + 2 × 500 M.C. Three of the four were successful, W/O Raton suffering a technical failure and returning to T.I.'s. There was little cloud over the target and the marking, which was continuous and accurate throughout, was plainly visible. The bombing was reported as accurate and P/O. McPherson saw numerous bomb bursts slightly W, of his T.I.'s about 40 seconds after bombing. Only F/L. Almond, who made his own bombing run despite an unserviceable gyre, reported any stray bombing and that consisted of one burst well to the S. W. of the T.I's. F/L. Caesar-Gordon reported 4 fires in the city, two of which were only 200 yards apart. The third was about three miles N.E. of these, and the fourth 2 miles to the west. The defences were not heavy, consisting of slight but accurate heavy flak and about 30/40 searchlights co-operating with the guns. F/L. Caesar-Gordon's aircraft, however, was hit and the main petrol tank holed. Three aircraft were ordered to attack Aachen with 3 x 500 N. C and 1 x 500 G.P.L.D. each and two aircraft attacked the primary with excellent results. F/G. Holland attacked the Aachen area. Opposition was negligible and the cloud over the target varied from 2/10 to 5/10. F/L. Ford (F/L. Millett) attacked the Rhenhausen area with 1 x 4000 H. C. There was 2/10 cloud in the area and opposition consisted of moderate, accurate heavy flak, and a few searchlights.

Place	Date	Time	Summary of Events.
Bourn	5.4.44	Day	Photographs taken of Vaires at 1220 hours on March 30th show that the main weight of the attack fell on the marshalling yard proper. In addition, small concentrations can be seen to the S. E. and W. The southern half of the engine sheds has been demolished and there is minor roof damage to the N. bay. In all three of the six bays have been destroyed. Scattered debris can be seen on the ground surrounding the sheds, possibly caused by bombs bursting in the building. There are at least two craters amongst locomotives outside the sheds and one locomotive is derailed. In the North marshalling sidings at least 33 hits have disorganised the centre and few tracks have escaped damage. A considerable amount of the rolling stock has been destroyed or damaged. At least 44 hits have been scored on the forwarding sidings. In the centre of the S. half is an area of complete devastation measuring 250 yards by 125 yards, too great to have been directly caused by bombs, and thought to have been caused by the explosion of two munition trains. Smoke was still rising from the wreckage when the photographs were taken and rails have been completely cut for a distance of 200 yards. Blast from the explosion has wrecked a great deal of rolling stock. A train of more than 12 trucks loaded with M. T. vehicles has received a direct hit. 121 hits are to be seen in the 3 marshalling yards, and on the N. side a train of about 40 trucks carrying A.F.V.'s (probably medium tanks) has received a direct hit. On the next road but one is another train carrying seven similar A.F.V.'s spaced one every fourth truck. Seven more A.F.V.'s are seen on the S. edge of the sidings, four on the ground and three on trucks. The W. and of the siding has been fairly heavily damaged and a considerable amount of rolling stock destroyed or damaged. In the Transhipment sidings there are at least 118 craters, some involving more than one road, and the loop lines in the W. sidings have been cut in eight places. Three hits have been scored on the E. bottlenecks. Six bays of an unidentified building N.W. of the yard have been gutted and so has another unidentified building north of the yard. The N. end of a roadbridge to the N.E. of the yard has been hit. The Town Slaughter House has been gutted and a considerable amount of rolling stock throughout the yards has been destroyed or damaged. The following message was received from the Air Officer Commanding in Chief, Bomber Command: 'Please convey to all operational squadrons my congratulations on their outstanding achievements in March. They may well be proud of the tremendous blows which they have dealt the enemy during this vital period. All previous records for sorties and bomb tonnages on objectives in Germany have been broken, in spite of difficult weather conditions and in the face of the bitterest opposition at the lowest casualty rate for the last thirteen months.' The Command dropped 28000 tons of bombs on enemy targets during March and made 2 attacks on Frankfurt during the course of each over three thousand tons were dropped, the second being a record of 3.200 tons.
Bourn	6.4.44	Night	Two aircraft attacked the east Railway Station at Aachen, dropping 6 × 500 M.C. + 2 × 500 G.P.L.D. through 10/10 cloud. No results were seen and only slight inaccurate heavy flak was encountered. F/L. Almond (F/O. Hunter) was unable to identify the primary target – the Ver Stahlwerke A.G. at Rheinhausen – so dropped 1 x 4000 H.C. in the Rheinhausen area. There was 10/10 cirrus over the target. Flak was moderate in intensity but inaccurate. One out of two aircraft attacked Hagen with 2 × 500 M.C. through 10/10 cloud. One by 500 G.P.L.D. + 1 x 500 M.G. hung up. F/L. Pereira suffered a technical failure and bombed the Hagen area. Opposition was negligible. F/L. Jordon (F/L. Byles) successfully attacked Cologne with 3 x 50 M.C. + 1 × 500 G.P.L.D. through 10/10 cloud. Here, too, opposition was negligible.
	7.4.44	Day	P/O. E.J. Gordon DFC. (Navigator) promoted to the war substantive rank of Flying Officer w.e.f. 18.3.44.

Place	Date	Time	Summary of Events.
	8.4.44	Night	Four out of four aircraft successfully groundmarked and bombed the Krupps works at Essen, dropping 8 × T.I. Green and 8 x 500 M.C. 8/10 cloud made observation of the T.I.'s very difficult but numerous bomb bursts were seen in the target area. There was moderate heavy flak. S/L Bird (F/L. Hildrew) attacked Osnabruck with 3 x 500 M.C. + 1 × 500 G.P.L.D. There was no opposition. W/O. Eaton (W/O. Fox) attacked the Ver Stahlwerke at Rheinhausen, dropping 1 x 4000 H.C. through 8/10 cloud with excellent results. The bomb was seen to explode. There was only slight flak.
	9.4.44	Night	The Squadron provided two aircraft + two reserves to mark Villeneuve St. Georges marshalling yards on the S. outskirts of Paris with 4 x L.B.T.I. Green each. There was no cloud over the target and visibility was very good when F/L/ Almond opened the attack in bright moonlight by dropping 2 x Green T.I's. F/O. Holland suffered a technical failure and made no attack, but F/L. Wolstenholme dropped 2 x T.I. Green in his place before F.L. Almond made his second run. S/L. Ford, a reserve, was not required to attack. 215 heavies formed the main force and 210 attacked the primary with good results, dropping 984 tons. A whitish yellow explosion was reported at 0003 hours and many smaller ones during the attack. The markers were easily seen and the bombing was well concentrated around them. 239 aircraft, including five aircraft from this Squadron, took part in a groundmarking attack on the marshalling yards at Lille dropping 1053 tons of bombs. Some of the markers were detailed to make two runs, but only F/L. Pereira was able to do this, dropping 2 L.B.T.I. Red on each run. F/L. Clayes failed on his first run but dropped 4 T.B.T.I. Green on the second run.
Bourn	1.6.44	Night	2/4 aircraft sky-marked a special target at Ferme d'Urville with 12 Red/Screen Stars Flares. There was 10/10ths. cloud over the target. S/Ldrs. Ford and F/Lt. Holliday were the successful captains.
	2.6.44	Night	17 aircraft operated during the night, 14 as markers and 3 with 4000 lb. bombs, 3/3 aircraft bombed Lison, dropping 3 x 4000 H.C., and nine of the groundmarkers were successful as follows. ½ on Wimereux, ½ on Neufchatel, 2/2 on Wissant, ½ on Calais, 2.2. on Berneval, 0/2 on Trappes and 2/2 on Harringszelles.
	3.6.44	Day	The following message was received from the A.C.C. –i-C Bomber Command through the A.C.C. P.F.F.: 'Form 'G' for June 3rd. shows 1179 bombers serviceable of an I.E. strength of 1179. Please inform all maintenance and administrative personnel concerned that this extraordinary degree of serviceability not only reflects the utmost credit upon their devoted efforts during these intensive operations but is and will be a major contribution towards winning the war.'
		Night	9 Aircraft operated, 3/3 successfully attacking Argentan dropping 3 x 4,000 H.C. with very good results. Targets at Wimereux, Calais and Ferme d'Urville were marked for forces of heavy bombers, ½ aircraft being successful on each target with the exception of Calais where both aircraft marked the primary.
	4.6.44	Night	12 aircraft operated, eight of them groundmarking for the main force. Of these ½ marked Sangatte, ½ Calais and 2/2 Maisy. S/L. Ford and P/O Eaton were both forced to withhold their T.I.'s at Boulogne due to their A.S.I.'s freezing up. ¾ aircraft attacked Argentan with 4000 1lb bombs At all the targets our aircraft were flying in cloud during the bombing run.
	5.6.44	Night	The Squadron put out the record number of sorties in any one night – 25 – to groundmark ten coastal batteries in support of the Allied invasion of Normandy. In all, Bomber Command sent out well over 1000 aircraft and dropped over 5000 tons. The batteries attacked were at Maisy, Mont Fleury, Moulgate, Longues, St. Pierre Outstreham, Grishecq, St. Martin de Verreville, Merville, Le Peronelle, all on the Cherbourg Peninsula. 19 of the 25 sorties were successful.
	6.6.44	Day	Early this morning Allied troops under the supreme command of General Eisenhower landed on the north coast of France at several points between Le Havre and Cherbourg. The main seaborne invasion was preceded by a gigantic airborne landing. Overwhelming air and sea bombardment covered the landings. At 1400 hours Wing Commander Cundall spoke to the aircrew. He told them that the work of the preceding night had put nearly all the coastal batteries in the Invasion area out of action. All leave would have to be suspended and 6 crews would be required to stand by at 30 minute readiness 24 hours to the day.

Place	Date	Time	Summary of Events.
			The normal working day for aircrew not at 30 minutes readiness would start at 1600 hours. No aircrew would be allowed away from the flights for more than 3 hours and then only on condition that they remained at the end of a telephone. All officers and airmen were ordered to carry arms at all times. The following message was received from the A.O.C. – in C Bomber Command through the A.O.C. P.F.F.: 'You did famously last night in the face of no mean difficulties. Fire from the Coastal Batteries which were your targets has been reported as virtually negligible. All four Radar Targets were put right out. The next few days will necessarily be the critical period of this operation. Calls upon you may be heavy and the weather may not be easy. I know that you will do your damnedest to meet all assignments with that efficiency and determination which was characterised the whole of your share of overload to date.'
	6.6.44	Day	F/L. J.E. Earnshaw detached to 1655 M.T.U. for Instructional duties.
		Night	F/O. (A/F/L) G.A. Caldwell IFM admitted to R.A.F. Hospital Halton. Once again 25 aircraft operated, this time groundmarking railway centres used by the enemy to bring up reinforcements to the beacheads. F/L. Wolstenholme returned early due to smoke in the cockpit and of the remaining 24 aircraft 13 were successful, attacking the primary. The targets attacked were at S. LO. Condi Sur Noireau, Argentan, Contances, Acherres, Chateauinin, Vire, Liseux and Caen.
	7.6.44	Night	The squadron despatched 15 sorties, 11 of which were successful. The Main attack was on a concentration of enemy tanks and A.P.V.'s in the Foret de Carisy a few miles S.W. of Caen. 4/5 aircraft dropped their T.I.'s, S/L. Helmore withholding his after a bad run in. 1000 tons was dropped on this target. In addition railway targets at Maissy, Juvisy, Versailles and Acheres were groundmarked.
	8.6.44	Day	F/O. (A/F/L) C. Chadwick DFC promoted to the War Substantive Rank of F/Lt. w.e.f. 6.5.44. F/O. P. Enderby promoted to the War Substantive Rank of F/Lt. w.e.f. 9.5.44. F/O. (A/F/L) J. Hall promoted to the War Substantive Rank of F/Lt. w.e.f. 1.5.44. F/L.R.E. Bray DFC awarded the First Bar to the Distinguished Flying Cross. F/I. (A/S/L) F. R. Bird, F/L. W. A. Christensen, F/L. G. H. Gilbert, F/O. (A/F/L) T. I. Hildrew, & F/L.C.V. Pereira awarded the Distinguished Flying Cross.
		Night	In very bad weather eleven aircraft groundmarked four railway targets south of the main battle area. The targets were at Fougeres, Mayenne, Rennes and Alenoon, 7 of our sorties were successful. The cloud base at Bourn for take off and landing was between 300' and 500' and 3 aircraft landed at Wyton, 1 at Oakington and 1 at Waterbeach.
	9.6.44	Night	Twelve aircraft operated, groundmarking airfields at Fiers, Le Mans, Rennes and Laval and the railway junction at Etampes. Etampes is on the main re-inforcement route to the Allied beachheads, and the four airfields are situated just behind the enemy lines and were being used as his main fighter bases. All the targets were cloud-covered but the 'heavies', roughly 100 of whom attacked each target, went below the cloud and good results were seen. Eight of our aircraft attacked successfully, a ninth suffering an armament failure after identifying the primary.
	10.6.44	Day	F/L. P. Sleight (Pilot) and F/O.D.L Mober (Nav) posted from 1655 M.T.U. for Organisational Aircrew duties.
		Night	Seven aircraft, 4 of which were successful, groundmarked railway targets at Versailles, Acherres and Dreux. These railways are on the main route by which enemy reinforcements can be moved up to the battle zone. The systematic bombing of these yards has forced the enemy to move their troops by the roundabout road route and great congestion can be seen on many of the roads. There was no cloud over any of the targets and although the wind veered and caused aircraft to be early, very good bombing results were seen.
	11.6.44	Day	F/L.G.K. Whiffen (Pilot), F/O. D.K. Williams (Nav), F/O. J.P. Molony (Pilot) and F/O. A.B.S. Lyndon (Nav) posted from 1655 M.T.U. for Operational Aircrew duties.
			In the first ten nights of the month the Squadron has despatched no less than 138 sorties for one early return. Almost 70% of these sorties have been successful. In the six nights of the 'Second Front' 98 sorties have been made, 50 of them in two consecutive nights. The following message has been received from H.Q.B.C. It is a copy of a message from 21 Army Group and dated June 9th. 'Much appreciate help given by Bomber Command and No.2 Group last night in spite of atrocious weather'.

Place	Date	Time	Summary of Events.
		Night	Night aircraft operated, groundmarking four railway targets. 2/3 aircraft successfully marked Evereux for 97/100 Lancasters and a highly concentrated attack developed. In addition to one large fire, several explosions, two of them particularly large, were reported. F/L. Ackroyd successfully identified the target but his T.I.'s hung up. 1/2 aircraft groundmarked the railway bridge at Massy for 65 Heavies. The markers were accurately placed and many large explosions were reported. 1/1 aircraft marked the Tours railway centre for 53 heavies. The marking and bombing were very accurate but haze and smoke prevented detailed observation of results. 1/2 aircraft attacked the Nantes railway centre backed by 54 heavies. The markers were well placed and a good attack developed.
	12.6.44	Night	Twenty one aircraft operated against six different targets, but only nine aircraft escaped technical trouble. Bomber Command despatched 1061 aircraft losing 40. The main target was the synthetic oil plant at Gelsenkirchen, which was marked by 1/4 of our aircraft for a force of 251/276 heavies. F/L. Jordans T.I.'s being hung up after he had identified the target. The weather was clear over the target and apart from a wild T.I. at first which attracted some bombing, the attack was well concentrated and some very healthy explosions caused clouds of black smoke. 17 Lancasters are missing.

Coastal Command crews load 60lb rocket projectiles onto a Mosquito sometime in December 1944.

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